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PCT/EP2003/008285

Cyclopenta[b]naphthalene derivatives

The present invention relates to cyclopenta[b]naphthalene derivatives, to the use thereof in liquid-crystalline or mesogenic media, to liquid-crystalline or mesogenic media comprising these derivatives, and to electro-optical display elements containing these liquid-crystalline or mesogenic media.

Liquid crystals have found widespread use since the first commercially usable liquid-crystalline compounds were found about 30 years ago. Known areas of application are, in particular, displays for watches and pocket calculators, and large display panels as used in railway stations, airports and sports arenas. Further areas of application are displays of portable computers and navigation systems and video applications. For the last-mentioned applications in particular, high demands are made of the response times and contrast of the images.

The spatial arrangement of the molecules in a liquid crystal has the effect that many of its properties are direction-dependent. Of particular importance for use in liquid-crystal displays are the optical, dielectric and elasto-mechanical anisotropies. Depending on whether the molecules are oriented with their longitudinal axes perpendicular or parallel to the two plates of a capacitor, the latter has a different capacitance; in other words, the dielectric constant ε of the liquid-crystalline medium has different values for the two orientations. Substances whose dielectric constant is larger in the case of a perpendicular orientation of the longitudinal axes of the molecules to the capacitor plates than in the case of a parallel arrangement are referred to as dielectrically positive. Most liquid crystals used in conventional displays fall into this group.

Both the polarisability of the molecule and permanent dipole moments play a role for the dielectric anisotropy. On application of a voltage to the display, the longitudinal axis of the molecules orients itself in such a way that the larger of the dielectric constants becomes effective. The strength of the interaction with the electric field depends on the difference between the two constants. In the case of small differences, higher switching voltages are necessary than in the case of large differences. The incorporation of suitable polar groups, such as, for example, nitrile groups or fluorine, into

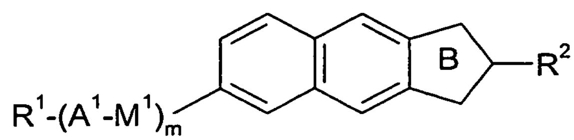
the liquid-crystal molecules enables a broad range of working voltages to be achieved.

In the case of the liquid-crystalline molecules used in conventional liquid-crystal displays, the dipole moment oriented along the longitudinal axis of the molecules is larger than the dipole moment oriented perpendicular to the longitudinal axis of the molecules. The orientation of the larger dipole moment along the longitudinal axis of the molecule also determines the orientation of the molecule in a liquid-crystal display in the field-free state. In the most widespread TN ("twisted nematic") cells, a liquid-crystalline layer with a thickness of only from about 5 to 10 μm is arranged between two flat glass plates, onto each of which an electrically conductive, transparent layer of tin oxide or indium tin oxide has been vapour-deposited as electrode. A likewise transparent alignment layer, which usually consists of a plastic (for example polyimides), is located between these films and the liquid-crystalline layer. This alignment layer serves to bring the longitudinal axes of the adjacent crystalline molecules into a preferential direction through surface forces in such a way that, in the voltage-free state, they lie uniformly on the inside of the display surface with the same orientation in a flat manner or with the same small tilt angle. Two polarisation films which only enable linear-polarised light to enter and escape are adhesively bonded to the outside of the display in a certain arrangement.

By means of liquid crystals in which the larger dipole moment is oriented parallel to the longitudinal axis of the molecule, very high-performance displays have already been developed. In most cases here, mixtures of from 5 to 20 components are used in order to achieve a sufficiently broad temperature range of the mesophase and short response times and low threshold voltages. However, difficulties are still caused by the strong viewing-angle dependence in liquid-crystal displays as are used, for example, for laptops. The best imaging quality can be achieved if the surface of the display is perpendicular to the viewing direction of the observer. If the display is tilted relative to the observation direction, the imaging quality drops drastically under certain circumstances. For greater comfort, attempts are being made to make the angle through which the display can be tilted from the viewing direction of an observer as large as possible. Attempts have recently been made to improve the viewing-angle

dependence using liquid-crystalline compounds whose dipole moment perpendicular to the longitudinal axis of the molecules is larger than that parallel to the longitudinal axis of the molecule. In the field-free state, these molecules are oriented perpendicular to the glass surface of the display. In this way, it has been possible to achieve an improvement in the viewing-angle dependence. Displays of this type are known as VA-TFT ("vertically aligned") displays.

DE 44 34 974 A1 discloses tricyclic compounds of the general formula

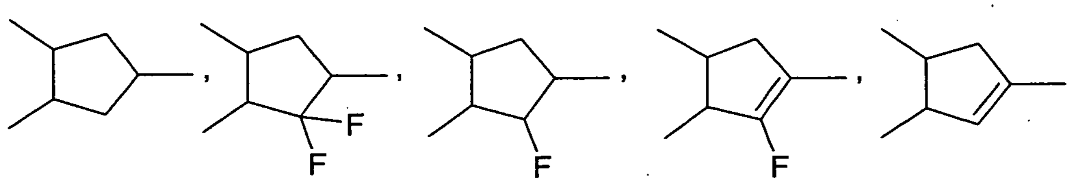


in which the symbols and indices have the following meanings:

R^1 is -F, -CN, -Cl, $-CF_3$ or has, independently of R^2, one of the meanings mentioned for R^2;

R^2 is H or a straight-chain or branched alkyl radical having from 1 to 20 carbon atoms (with or without an asymmetrical carbon atom), in which, in addition, one or more $-CH_2-$ groups (but not those bonded directly to the five-membered ring) may be replaced by -O-, -S-, -CH=CH-, -C≡C-, cyclopropane-1,2-diyl, $-Si(CH_3)_2-$, 1,4-phenylene, 1,4-cyclohexylene, 1,3-cyclopentylene, 1,3-cyclobutylene, 1,3-dioxane-2,5-diyl, with the proviso that oxygen atoms and sulfur atoms must not be bonded directly, and in which, in addition, one or more H atoms of the alkyl radical may be substituted by F, Cl, Br or OR^3, or an optically active or racemic group;

Ring B is



A^1 is 1,4-phenylene, 1,4-cyclohexylene, pyridine-2,5-diyl, pyrimidine-2,5-diyl, 1,3-thiazole-2,5-diyl, 1,3-thiazole-2,4-diyl, in which, in addition, one or more hydrogens may be substituted by F, 1,3,4-thiadiazole-2,5-diyl;

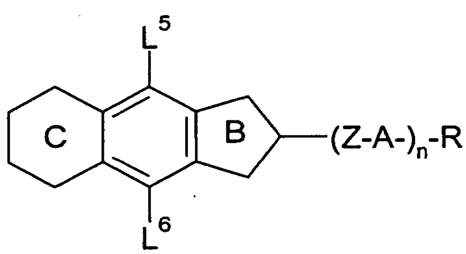
M^1 is a single bond, -C≡C-, $-CH_2CH_2-$, -O-CO-, -CO-O-, -CO-, $-OCH_2-$, $-CH_2O-$ or -O-CO-O-; and m is zero or one.

However, the Δε of the compounds disclosed in this document is not sufficient to ensure satisfactory properties, for example in VA-TFT displays.

Development in the area of liquid-crystalline materials is far from complete. In order to improve the properties of liquid-crystalline display elements, attempts are constantly being made to develop novel compounds which enable such displays to be optimised.

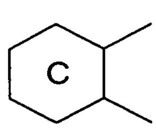
An object of the present invention was to provide compounds having advantageous properties for use in liquid-crystalline media.

This object is achieved in accordance with the invention by cyclopenta[b]-naphthalene derivatives of the general formula (I)



(I)

in which:



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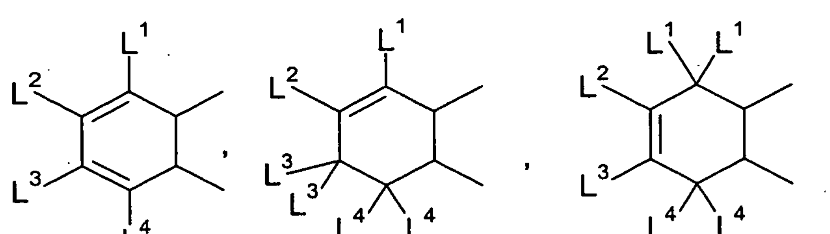

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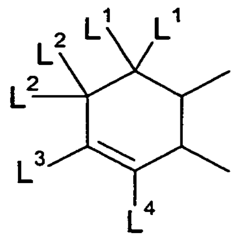
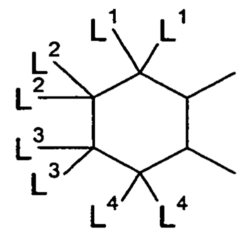
 , 

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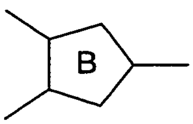
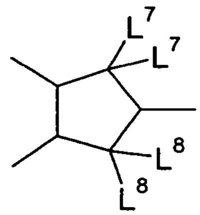
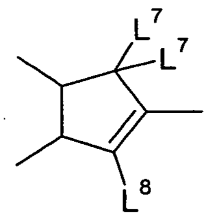
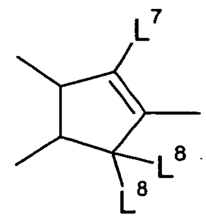
 is  ,  , 

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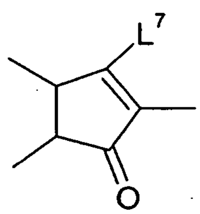
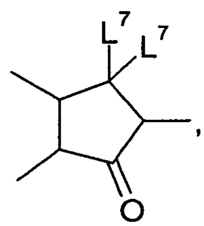
 ,  ,

d e

Z is in each case, independently of one another, a single bond, a double bond, $-CF_2O-$, $-OCF_2-$, $-CH_2CH_2-$, $-CF_2CF_2-$, -C(O)O-, -OC(O)-, $-CH_2O-$, $-OCH_2-$, -CF=CH-, -CH=CF-, -CF=CF-, -CH=CH- or -C≡C-,

A is in each case, independently of one another, 1,4-phenylene, in which =CH- may be replaced once or twice by =N-, and which may be monosubstituted to tetrasubstituted, independently of one another, by halogen (-F, -Cl, -Br, -I), -CN, $-CH_3$, $-CH_2F$, $-CHF_2$, $-CF_3$, $-OCH_3$, $-OCH_2F$, $-OCHF_2$ or $-OCF_3$, 1,4-cyclohexylene, 1,4-cyclohexenylene or 1,4-cyclohexadienylene, in which $-CH_2-$ may be replaced once or twice, independently of one another, by -O- or -S- in such a way that heteroatoms are not directly adjacent, and

which may be monosubstituted or polysubstituted by halogen, or is 1,3-cyclobutylene or bicyclo[2.2.2]octane,

R is hydrogen, an alkyl, alkoxy, alkenyl or alkynyl radical having from 1 to 15 or 2 to 15 carbon atoms respectively which is unsubstituted, monosubstituted by $-CF_3$ or at least monosubstituted by halogen, where, in addition, one or more CH_2 groups in these radicals may each, independently of one another, be replaced by -O-, -S-, -CO-, -COO-, -OCO- or -OCO-O- in such a way that heteroatoms are not directly adjacent, halogen, -CN, -SCN, -NCS, $-SF_5$, $-CF_3$, $-OCF_3$, $-OCHF_2$ or $-OCH_2F$,

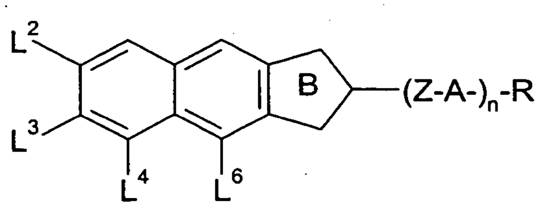
n is 0, 1, 2 or 3, and

L^1 - L^8 are each, independently of one another, hydrogen, an alkyl, alkoxy, alkenyl or alkynyl radical having from 1 to 15 or 2 to 15 carbon atoms respectively which is unsubstituted or at least monosubstituted by halogen, where, in addition, one or more CH_2 groups in these radicals may each, independently of one another, be replaced by -O-, -S-, -CO-, -COO-, -OCO- or -OCO-O- in such a way that heteroatoms are not directly adjacent, halogen, -CN, -SCN, -NCS, $-SF_5$, $-CF_3$, $-OCF_3$, $-OCHF_2$, $-OCH_2F$ or $-(Z-A-)_n-R$.

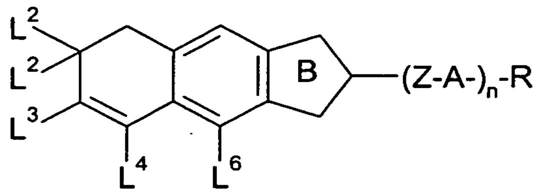
A further object of the present invention was to provide liquid-crystalline compounds, in particular for use in VA-TFT displays.

This object is achieved in accordance with the invention by the provision of cyclopenta[b]naphthalene derivatives of negative $\Delta\varepsilon$.

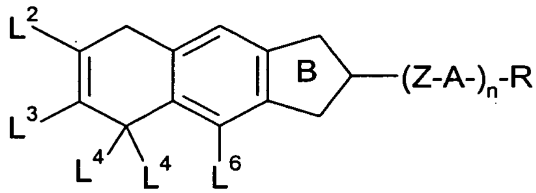
The present invention thus relates, in particular, to cyclopenta[b]naphthalene derivatives of the general formulae (II) to (VI)



(II)



(III)



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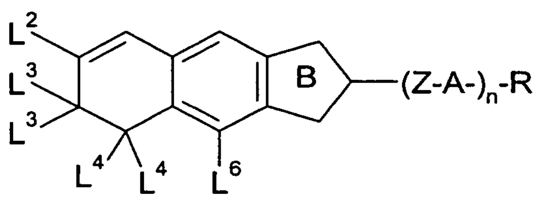

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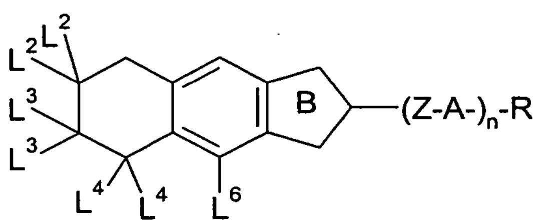

(VI)

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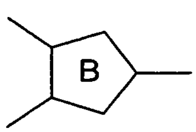

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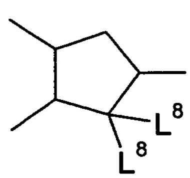

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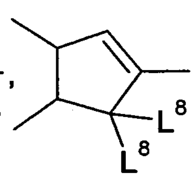

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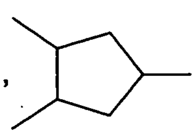

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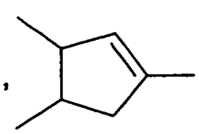

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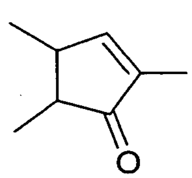

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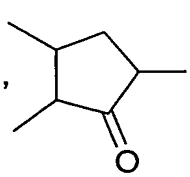

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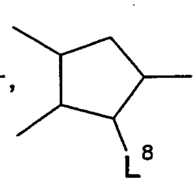

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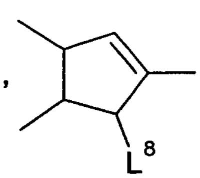

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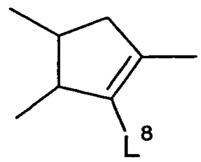
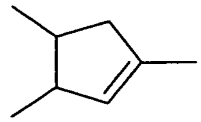
 or 

i j

Z is in each case, independently of one another, a single bond, a double bond, $-CF_2O-$, $-OCF_2-$, $-CH_2CH_2-$, $-CF_2CF_2-$, -C(O)O-, -OC(O)-, $-CH_2O-$, $-OCH_2-$, -CF=CH-, -CH=CF-, -CF=CF-, -CH=CH- or -C≡C-,

A is in each case, independently of one another, 1,4-phenylene, in which =CH- may be replaced once or twice by =N-, and which may be monosubstituted to tetrasubstituted, independently of one another, by halogen (-F, -Cl, -Br, -I), -CN, $-CH_3$, $-CH_2F$, $-CHF_2$, $-CF_3$, $-OCH_3$, $-OCH_2F$, $-OCHF_2$ or $-OCF_3$, 1,4-cyclohexylene, 1,4-cyclohexenylene or 1,4-cyclohexadienylene, in which $-CH_2-$ may be replaced once or twice, independently of one another, by -O- or -S- in such a way that heteroatoms are not directly adjacent, and which may be monosubstituted or polysubstituted by halogen, or is 1,3-cyclobutylene or bicyclo[2.2.2]octane,

R is hydrogen, an alkyl, alkoxy, alkenyl or alkynyl radical having from 1 to 15 or 2 to 15 carbon atoms respectively which is unsubstituted, monosubstituted by $-CF_3$ or at least monosubstituted by halogen, where, in addition, one or more CH_2 groups in these radicals may each, independently of one another, be replaced by -O-, -S-, -CO-, -COO-, -OCO- or -OCO-O- in such a way that heteroatoms are not directly adjacent, halogen, -CN, -SCN, -NCS, $-SF_5$, $-CF_3$, $-OCF_3$, $-OCHF_2$ or $-OCH_2F$,

L^2, L^3 and L^8 are each, independently of one another, hydrogen, an alkyl, alkoxy, alkenyl or alkynyl radical having from 1 to 15 or 2 to 15 carbon atoms respectively which is unsubstituted or at least monosubstituted by halogen, where, in addition, one or more CH_2 groups in these radicals may each, independently of one another,

be replaced by -O-, -S-, -CO-, -COO-, -OCO- or -OCO-O- in such a way that heteroatoms are not directly adjacent, halogen, -CN, -SCN, -NCS, $-SF_5$, $-CF_3$, $-OCF_3$, $-OCHF_2$, $-OCH_2F$ or $-(Z-A-)_n-R$,

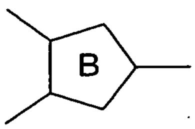
L^4 and L^6 are each, independently of one another, hydrogen, an alkyl, alkoxy, alkenyl or alkynyl radical having from 1 to 15 or 2 to 15 carbon atoms respectively which is at least monosubstituted by halogen, where, in addition, one or more CH_2 groups in these radicals may each, independently of one another, be replaced by -O-, -S-, -CO-, -COO-, -OCO- or -OCO-O- in such a way that heteroatoms are not directly adjacent, halogen, -CN, $-SF_5$, -SCN, -NCS, $-CF_3$, $-OCF_3$, $-OCHF_2$ or $-OCH_2F$, preferably with the proviso that L^4 and L^6 cannot simultaneously be hydrogen, and

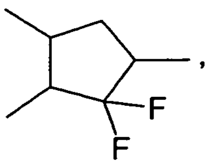
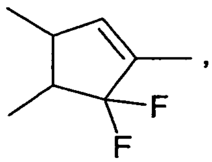
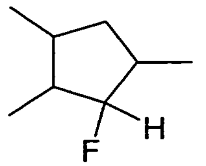
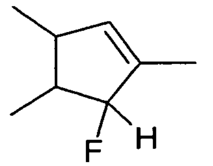
n is 0, 1, 2 or 3.

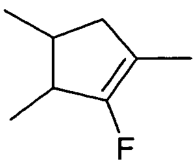
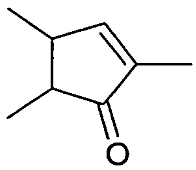
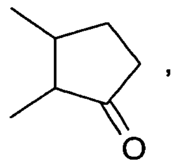
Preference is given to cyclopenta[b]naphthalene derivatives of the general formulae (II), (III), (V) and (VI), and particular preference is given to cyclopenta[b]naphthalene derivatives of the general formulae (II) and (VI).

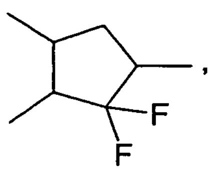
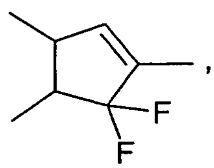
The compounds all have negative $\Delta\varepsilon$ and are therefore suitable, in particular, for use in VA-TFT displays. The compounds according to the invention preferably have a $\Delta\varepsilon$ of < -2 and particularly preferably a $\Delta\varepsilon$ of < -5. They exhibit very good compatibility with the conventional substances used in liquid-crystal mixtures for displays.

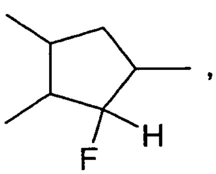
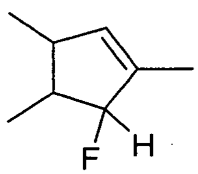
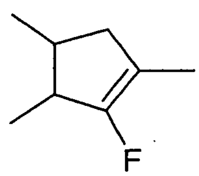
The substituents, preferably fluorine substituents, in the naphthalene structure and the electronegative atoms in ring B generate a dipole moment perpendicular to the longitudinal axis of the molecules, which can, if desired, be further strengthened by suitable substituents in the wing units $-(Z-A-)_n-R$. In the field-free state, the compounds of the formulae (II) to (VI) orient themselves with their longitudinal axis of the molecules perpendicular to the treated or coated glass surface of the display.

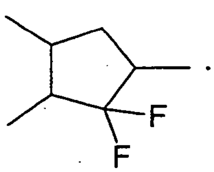
 in the general formulae (II) to (VI) are preferably

  or 

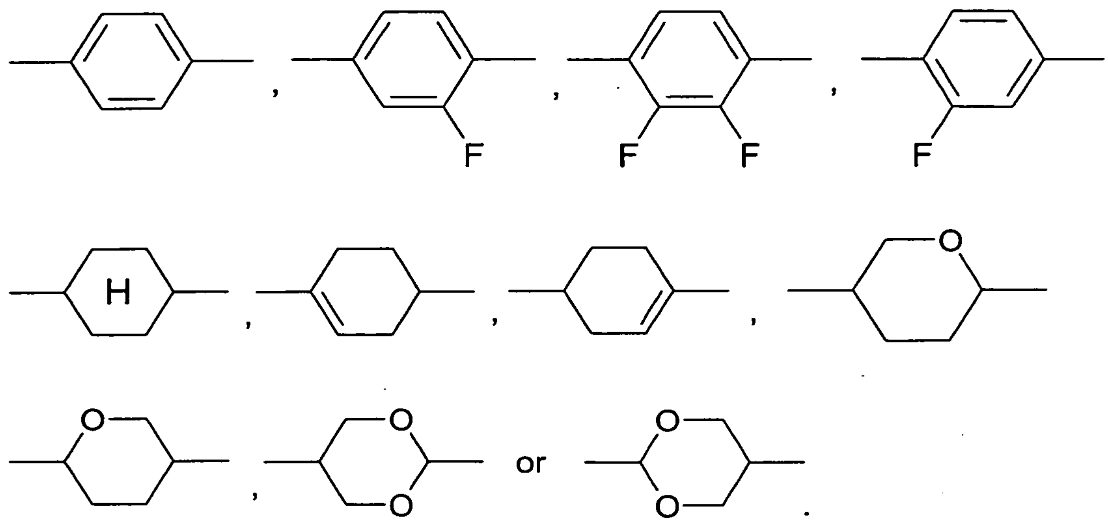
particularly preferably  

  or  and in particular



In the general formulae (II) to (VI), A are preferably, independently of one another, optionally substituted 1,4-phenylene, optionally substituted 1,4-cyclohexylene, in which $-CH_2-$ may be replaced once or twice by -O-, or optionally substituted 1,4-cyclohexenylene.

A are particularly preferably, independently of one another,



Preferred groups Z in the compounds of the general formulae (II) to (VI) are each, independently of one another, a single bond, $-CF_2O-$, $-OCF_2-$, $-CF_2CF_2-$, -CH=CH-, -CF=CH-, -CH=CF- or -CF=CF-, particularly preferably a single bond, $-CF_2O-$, $-OCF_2-$, $-CF_2CF_2-$, -CF=CH-, -CH=CF- or -CF=CF-.

R, L^2 and L^3 in the general formulae (II) to (VI) may each, independently of one another, be an alkyl radical and/or an alkoxy radical having from 1 to 15 carbon atoms, which may be straight-chain or branched. It is preferably straight-chain, has 1, 2, 3, 4, 5, 6 or 7 carbon atoms and accordingly is preferably methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, methoxy, ethoxy, propoxy, butoxy, pentoxy, hexyloxy or heptyloxy.

R, L^2 and L^3 may each, independently of one another, be oxaalkyl, preferably straight-chain 2-oxapropyl (= methoxymethyl), 2- (= ethoxymethyl) or 3-oxabutyl (= methoxyethyl), 2-, 3- or 4-oxapentyl, 2-, 3-, 4- or 5-oxahexyl, 2-, 3-, 4-, 5- or 6-oxaheptyl.

R, L^2 and L^3 may each, independently of one another, be an alkenyl radical having from 2 to 15 carbon atoms, which may be straight-chain or branched. It is preferably straight-chain and has from 2 to 7 carbon atoms. Accordingly, it is preferably vinyl, prop-1- or prop-2-enyl, but-1-, 2- or but-3-enyl, pent-1-, 2-, 3- or pent-4-enyl, hex-1-, 2-, 3-, 4- or hex-5-enyl, hept-1-, 2-, 3-, 4-, 5- or hept-6-enyl.

R, L^2 and L^3 may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms in which one CH_2 group has been replaced by -O- and one has been replaced by -CO-, where these are preferably adjacent. This thus contains an acyloxy group -CO-O- or an oxycarbonyl group -O-CO-. This is preferably straight-chain and has from 2 to 6 carbon atoms.

R, L^2 and L^3 may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms in which one CH_2 group has been replaced by unsubstituted or substituted -CH=CH- and an adjacent CH_2 group has been replaced by CO or CO-O or O-CO, where this may be straight-chain or branched. It is preferably straight-chain and has from 4 to 13 carbon atoms.

R, L^2 and L^3 may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms or alkenyl radical having from 2 to 15 carbon atoms, each of which is monosubstituted by -CN or $-CF_3$, where these are preferably straight-chain. The substitution by -CN or $-CF_3$ is possible in any desired position.

R, L^2 and L^3 may each, independently of one another, be an alkyl radical in which two or more CH_2 groups have been replaced by -O- and/or -CO-O-, where this may be straight-chain or branched. It is preferably branched and has from 3 to 12 carbon atoms.

R, L^2, L^3, L^4 and L^6 may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms or alkenyl radical having from 2 to 15 carbon atoms, each of which is at least monosubstituted by halogen, where these radicals are preferably straight-chain and halogen is preferably -F or -Cl. In the case of polysubstitution, halogen is preferably -F. The resultant radicals also include perfluorinated radicals, such as $-CF_3$. In the case of monosubstitution, the fluorine or chlorine substituent can be in any desired position, but is preferably in the ω-position.

R in the general formulae (II) to (VI) is particularly preferably an alkyl radical, alkoxy radical or alkenyl radical having from 1 to 7 or 2 to 7 carbon atoms respectively.

L^2 and L^3 in the general formulae (II) to (VI) is preferably hydrogen, an alkyl radical, alkoxy radical or alkenyl radical having from 1 to 7 or 2 to 7 carbon atoms respectively or a halogen, particularly preferably hydrogen, an alkoxy radical having from 1 to 7 carbon atoms, fluorine or chlorine, and in particular fluorine.

L^4 and L^6 in the general formulae (II) to (VI) is preferably hydrogen, an alkyl radical, alkoxy radical or alkenyl radical having from 1 to 7 or 2 to 7 carbon atoms respectively, each of which is at least monosubstituted by halogen, or a halogen, particularly preferably $-CF_3$, fluorine or chlorine, and in particular fluorine.

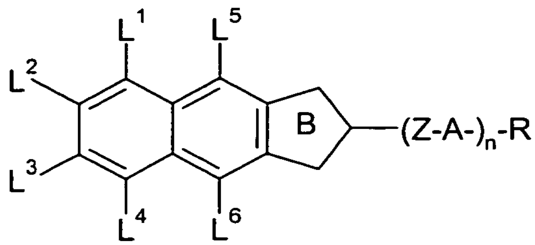
L^8 in the general formulae (II) to (VI) is preferably fluorine.

Preferred compounds of the general formulae (II) to (VI) have no, one or two wing units ZA, i.e. n = 0, 1 or 2, particularly preferably n = 1.

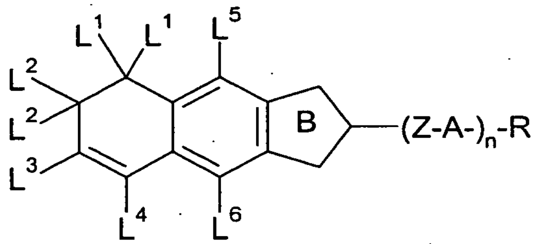
A further object of the present invention was to provide compounds, in particular for use in mesogenic control media, where these control media are employed, in particular, in electro-optical light-control elements which are operated at a temperature at which the mesogenic control medium in the unaddressed state is in the isotropic phase.

This object is achieved in accordance with the invention by the provision of cyclopenta[b]naphthalene derivatives of positive $\Delta\varepsilon$.

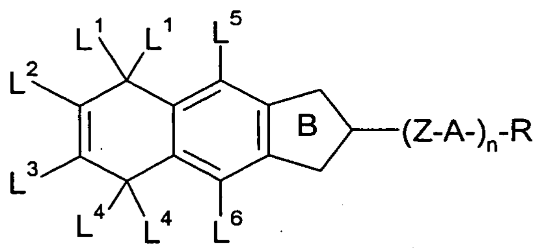
The present invention thus relates, in particular, to cyclopenta[b]naphthalene derivatives of the general formulae (VII) to (XI)



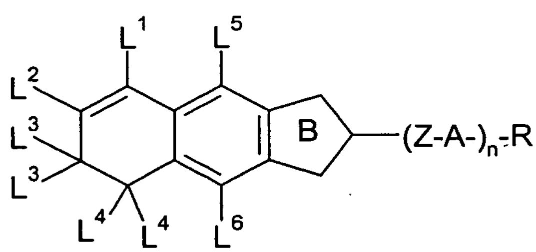
(VII)



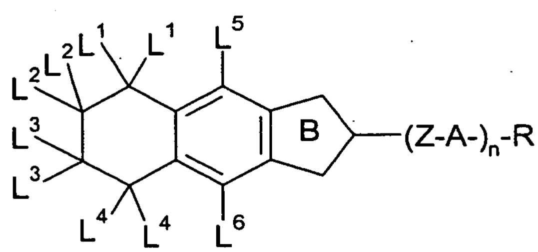
(VIII)



(IX)

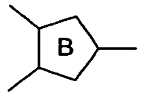


(X)



(XI)

in which Z, A, R, n, L^1 to L^8 and

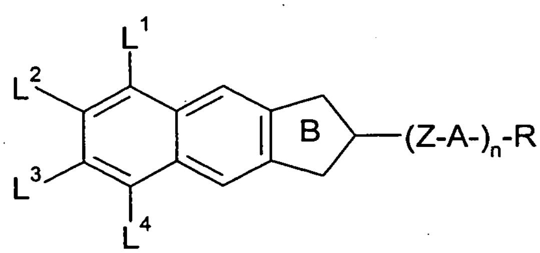


have the meanings indicated in relation to the formula (I).

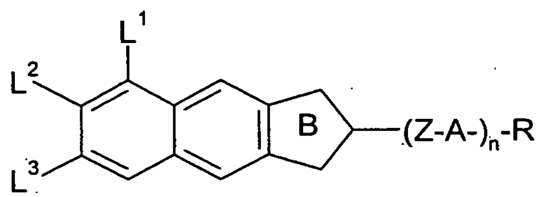
Preference is given to cyclopenta[b]naphthalene derivatives of the general formulae (VII) and (XI), and particular preference is given to cyclopenta[b]-naphthalene derivatives of the general formula (VII).

The compounds of the formulae (VII) to (XI) all have positive $\Delta\varepsilon$. The compounds of the formulae (VII) to (XI) according to the invention preferably have a $\Delta\varepsilon$ of > +10, particularly preferably a $\Delta\varepsilon$ of > +15 and in particular a $\Delta\varepsilon$ of > +20. They exhibit very good compatibility with the conventional substances used in mesogenic control media.

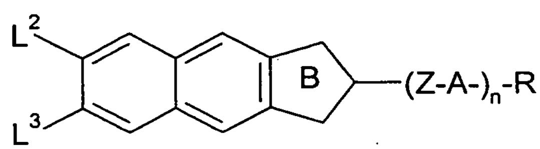
The cyclopenta[b]naphthalene derivatives of the general formula (VII) preferably have the following structural formulae:



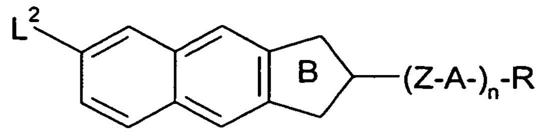
(VIIa)



(VIIb)

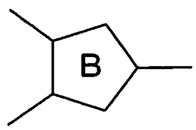


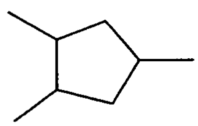
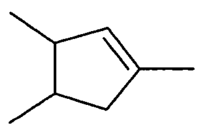
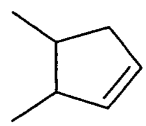
(VIIc)

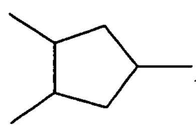


(VIId)

where the structural formulae (VIIa) and (VIIc) are particularly preferred.

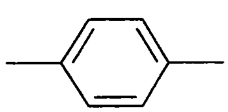
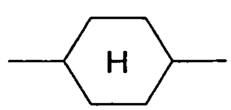
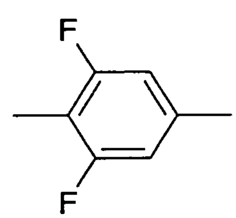
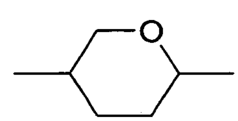
 in the general formulae (VII) to (XI) are preferably

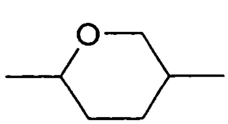
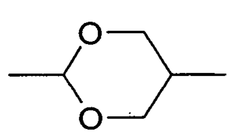
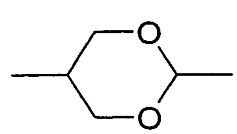
 ,  or  ,

particularly preferably 

In the general formulae (VII) to (XI), A are preferably, independently of one another, optionally substituted 1,4-phenylene, optionally substituted 1,4-cyclohexylene, in which $-CH_2-$ may be replaced once or twice by -O-, or optionally substituted 1,4-cyclohexenylene.

A are particularly preferably, independently of one another,

 ,  ,  , 

 ,  or 

Preferred groups Z in the compounds of the general formulae (VII) to (XI) are each, independently of one another, a single bond, $-CF_2O-$, $-OCF_2-$, $-CF_2CF_2-$, -CH=CH-, -CF=CH-, -CH=CF- or -CF=CF-, particularly preferably a single bond, $-CF_2O-$, $-OCF_2-$, $-CF_2CF_2-$ or -CF=CF-.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkyl radical and/or an alkoxy radical having from 1 to 15 carbon atoms, which may be straight-chain or branched. It is preferably straight-chain, has 1, 2, 3, 4, 5, 6 or 7 carbon atoms and accordingly is preferably methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, methoxy, ethoxy, propoxy, butoxy, pentoxy, hexoxy or heptoxy.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be oxaalkyl, preferably straight-chain 2-oxapropyl (= methoxymethyl), 2- (= ethoxymethyl) or 3-oxabutyl (= methoxyethyl), 2-, 3- or 4-oxapentyl, 2-, 3-, 4- or 5-oxahexyl, 2-, 3-, 4-, 5- or 6-oxaheptyl.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkenyl radical having from 2 to 15 carbon atoms, which may be straight-chain or branched. It is preferably straight-chain and has from 2 to 7 carbon atoms. Accordingly, it is preferably vinyl, prop-1- or prop-2-enyl, but-1-, 2- or but-3-enyl, pent-1-, 2-, 3- or pent-4-enyl, hex-1-, 2-, 3-, 4- or hex-5-enyl, hept-1-, 2-, 3-, 4-, 5- or hept-6-enyl.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms in which one CH_2 group has been replaced by -O- and one has been replaced by -CO-, where these are preferably adjacent. This thus contains an acyloxy group -CO-O- or an oxycarbonyl group -O-CO-. This is preferably straight-chain and has from 2 to 6 carbon atoms.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms in which one CH_2 group has been replaced by unsubstituted or substituted -CH=CH- and an adjacent CH_2 group has been replaced by CO or CO-O or O-CO, where this may be straight-chain or branched. It is preferably straight-chain and has from 4 to 13 carbon atoms.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms or alkenyl radical having from 2 to 15 carbon atoms, each of which is monosubstituted by -CN or $-CF_3$, where these are preferably straight-chain. The substitution by -CN or $-CF_3$ is possible in any desired position.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkyl radical in which two or more CH_2 groups have been replaced by -O- and/or -CO-O-, where this may be straight-chain or branched. It is preferably branched and has from 3 to 12 carbon atoms.

R and L^1 to L^8 in the general formulae (VII) to (XI) may each, independently of one another, be an alkyl radical having from 1 to 15 carbon atoms or alkenyl radical having from 2 to 15 carbon atoms, each of which is at least monosubstituted by halogen, where these radicals are preferably straight-chain and halogen is preferably -F or -Cl. In the case of polysubstitution, halogen is preferably -F. The resultant radicals also include perfluorinated radicals, such as $-CF_3$. In the case of monosubstitution, the fluorine or chlorine substituent can be in any desired position, but is preferably in the ω-position.

R in the general formulae (VII) to (XI) is particularly preferably an alkyl radical, alkoxy radical or alkenyl radical having from 1 to 7 or 2 to 7 carbon atoms respectively, in particular an alkyl radical having from 1 to 7 carbon atoms.

L^2 and L^3 in the general formulae (VII) to (XI) is preferably, independently of one another, identical or different and is hydrogen, halogen, -CN, -SCN, -NCS, $-SF_5$, $-CF_3$, $-CHF_2$, $-OCF_3$ or $-OCHF_2$, particularly preferably hydrogen, fluorine, $-CF_3$ or $-OCF_3$. In particular, however, L^2 and/or L^3 is not hydrogen.

L^1 and L^4 in the general formulae (VII) to (XI) is preferably, independently of one another, identical or different and is hydrogen or fluorine. Particularly preferably, however, $L^1 = L^4 = H$ or $L^1 = L^4 = F$.

L^5 and L^6 in the general formulae (VII) to (XI) is preferably hydrogen.

Particular preference is given to compounds of the general formulae (VII) to (XI) in which L1 = L2 = L3 = L4 = F and L5 = L6 = H.

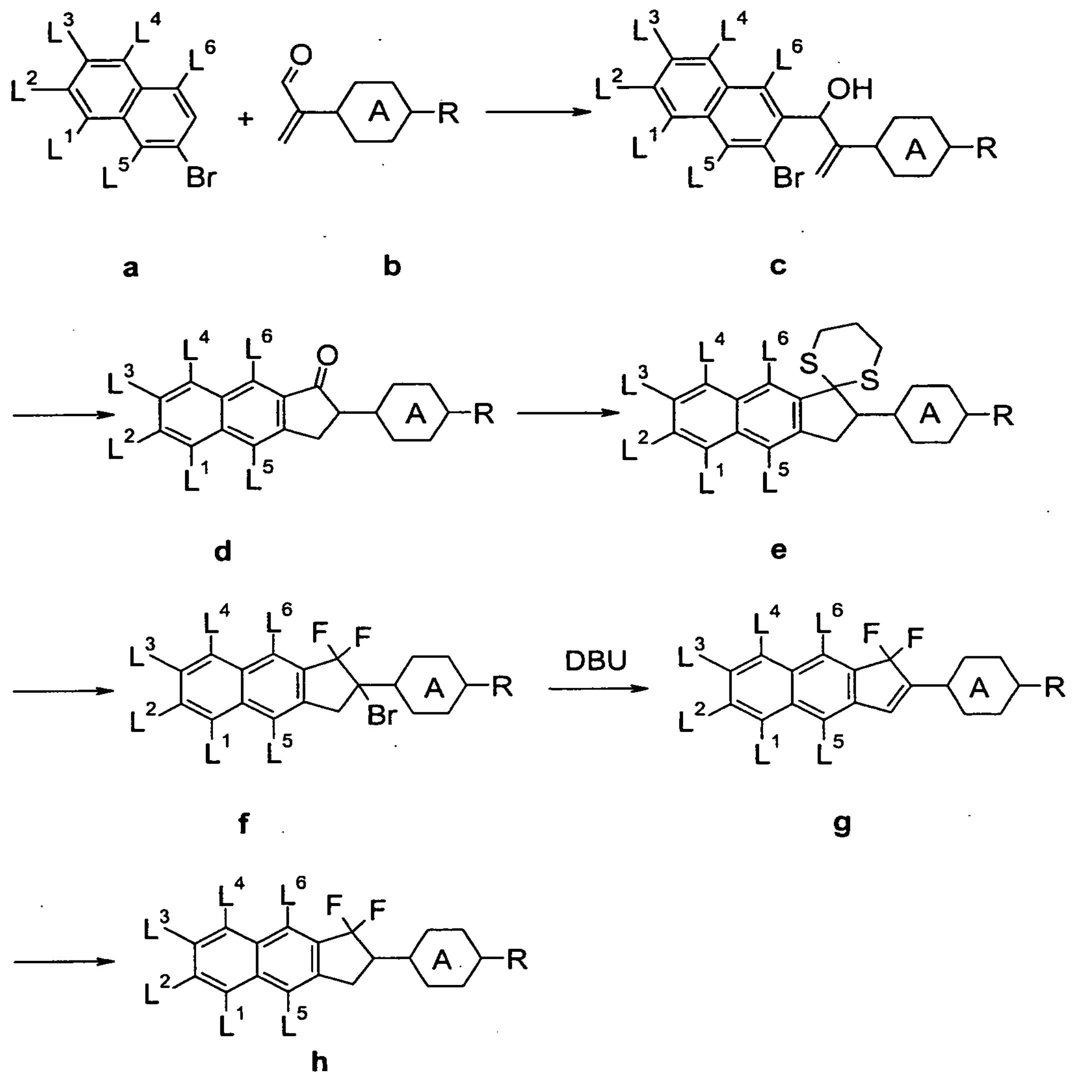
Preferred compounds of the general formulae (VII) to (XI) have no, one or two wing units ZA, i.e. n = 0, 1 or 2, particularly preferably n = 1.

The compounds of the general formulae (I), (II) to (VI) and (VII) to (XI) are prepared by methods known per se, as described in the literature (for example in the standard works, such as Houben-Weyl, Methoden der organischen Chemie [Methods of Organic Chemistry], Georg-Thieme-Verlag, Stuttgart), to be precise under reaction conditions which are known and are suitable for the said reactions. Use can be made here of variants known per se, which are not mentioned here in greater detail.

If desired, the starting materials can also be formed in situ by not isolating them from the reaction mixture, but instead immediately converting them further into the compounds of the general formulae (I) to (XI).

The syntheses of various polysubstituted naphthalene derivatives which are used to build up the five-membered ring are described by way of example in the examples. The starting substances are obtainable by generally accessible literature procedures or commercially. The reactions described should likewise be regarded as known from the literature.

An illustrative synthesis for building up the five-membered ring is shown below. The synthesis can be adapted to the particular desired compounds of the general formulae (I) to (XI) through the choice of suitable starting materials.



Starting from the 3-bromonaphthalene **a**, reaction with an α,β-unsaturated aldehyde **b** in the presence of lithium diisopropylamide (LDA) gives compound **c**. This reacts with palladium catalysis in the presence of triethylamine with ring closure to give the ketone **d**. From the ketone **d** and 1,3-propanedithiol in the presence of BF_3/diethyl ether, the corresponding dithiane **e** is obtained. This is reacted with 1,3-dibromo-5,5-dimethylhydantoin (DBH) and HF in pyridine to give the cyclopenta[b]naphthalene derivative **f**. Elimination of HBr in the presence of diazabicycloundecene (DBU) gives the cyclopenta[b]naphthalene derivative **g**. The cyclopenta[b]naphthalene derivative **g** is hydrogenated on the palladium/carbon catalyst in a hydrogen atmosphere to give the cyclopenta[b]naphthalene derivative **h**.

The reactions described should only be regarded as illustrative. The person skilled in the art can carry out corresponding variations of the syntheses described and also follow other suitable synthetic routes in order to obtain compounds of the formulae (I) to (XI).

As already mentioned, the compounds of the general formulae (I) to (XI) can be used in liquid-crystalline media.

The present invention therefore also relates to a liquid-crystalline medium comprising at least two liquid-crystalline compounds, comprising at least one compound of the general formulae (I) to (XI).

The present invention also relates to liquid-crystalline media comprising from 2 to 40, preferably from 4 to 30, components as further constituents besides one or more compounds of the formulae (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X) and/or (XI) according to the invention. These media particularly preferably comprise from 7 to 25 components besides one or more compounds according to the invention. These further constituents are preferably selected from nematic or nematogenic (monotropic or isotropic) substances, in particular substances from the classes of the azoxybenzenes, benzylideneanilines, biphenyls, terphenyls, phenyl or cyclohexyl benzoates, phenyl or cyclohexyl esters of cyclohexanecarboxylic acid, phenyl or cyclohexyl esters of cyclohexylbenzoic acid, phenyl or cyclohexyl esters of cyclohexylcyclohexanecarboxylic acid, cyclohexylphenyl esters of benzoic acid, of cyclohexanecarboxylic acid or of cyclohexylcyclohexanecarboxylic acid, phenylcyclohexanes, cyclohexylbiphenyls, phenylcyclohexylcyclohexanes, cyclohexylcyclohexanes, cyclohexylcyclohexylcyclohexenes, 1,4-biscyclohexylbenzenes, 4',4'-biscyclohexylbiphenyls, phenyl- or cyclohexylpyrimidines, phenyl- or cyclohexylpyridines, phenyl- or cyclohexyldioxanes, phenyl- or cyclohexyl-1,3-dithianes, 1,2-diphenylethanes, 1,2-dicyclohexylethanes, 1-phenyl-2-cyclohexylethanes, 1-cyclohexyl-2-(4-phenylcyclohexyl)ethanes, 1-cyclohexyl-2-biphenylethanes, 1-phenyl-2-cyclohexylphenylethanes, optionally halogenated stilbenes, benzyl phenyl ethers, tolans and substituted cinnamic acids. The 1,4-phenylene groups in these compounds may also be fluorinated.

The most important compounds suitable as further constituents of media according to the invention can be characterised by the formulae (1), (2), (3), (4) and (5):

R'-L-E-R"	(1)
R'-L-COO-E-R"	(2)
R'-L-OOC-E-R"	(3)
R'-L-CH_2CH_2-E-R"	(4)
R'-L-CF_2O-E-R"	(5)

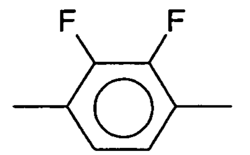
In the formulae (1), (2), (3), (4) and (5), L and E, which may be identical or different, are each, independently of one another, a divalent radical from the group formed by -Phe-, -Cyc-, -Phe-Phe-, -Phe-Cyc-, -Cyc-Cyc-, -Pyr-, -Dio-, -G-Phe- and -G-Cyc- and their mirror images, where Phe is unsubstituted or fluorine-substituted 1,4-phenylene, Cyc is trans-1,4-cyclohexylene or 1,4-cyclohexylene, Pyr is pyrimidine-2,5-diyl or pyridine-2,5-diyl, Dio is 1,3-dioxane-2,5-diyl, and G is 2-(trans-1,4-cyclohexyl)ethyl.

One of the radicals L and E is preferably Cyc or Phe. E is preferably Cyc, Phe or Phe-Cyc. The media according to the invention preferably comprise one or more components selected from the compounds of the formulae (1), (2), (3), (4) and (5) in which L and E are selected from the group consisting of Cyc and Phe and simultaneously one or more components selected from the compounds of the formulae (1), (2), (3), (4) and (5) in which one of the radicals L and E is selected from the group consisting of Cyc and Phe and the other radical is selected from the group consisting of -Phe-Phe-, -Phe-Cyc-, -Cyc-Cyc-, -G-Phe- and -G-Cyc-, and optionally one or more components selected from the compounds of the formulae (1), (2), (3), (4) and (5) in which the radicals L and E are selected from the group consisting of -Phe-Cyc-, -Cyc-Cyc-, -G-Phe- and -G-Cyc-.

In a smaller sub-group of the compounds of the formulae (1), (2), (3), (4) and (5), R' and R" are each, independently of one another, alkyl, alkenyl, alkoxy, alkoxyalkyl, alkenyloxy or alkanoyloxy having up to 8 carbon atoms. This smaller sub-group is called group A below, and the compounds are referred to by the sub-formulae (1a), (2a), (3a), (4a) and (5a). In most of

these compounds, R' and R" are different from one another, one of these radicals usually being alkyl, alkenyl, alkoxy or alkoxyalkyl.

In another smaller sub-group of the compounds of the formulae (1), (2), (3), (4) and (5), which is referred to as group B, E is



In the compounds of group B, which are referred to by the sub-formulae (1b), (2b), (3b), (4b) and (5b), R' and R" are as defined for the compounds of the sub-formulae (1a) to (5a) and are preferably alkyl, alkenyl, alkoxy or alkoxyalkyl.

In a further smaller sub-group of the compounds of the formulae (1), (2), (3), (4) and (5), R" is –CN; this sub-group is referred to below as group C, and the compounds of this sub-group are correspondingly described by sub-formulae (1c), (2c), (3c), (4c) and (5c). In the compounds of the sub-formulae (1c), (2c), (3c), (4c) and (5c), R' is as defined for the compounds of the sub-formulae (1a) to (5a) and is preferably alkyl, alkenyl, alkoxy or alkoxyalkyl.

Besides the preferred compounds of groups A, B and C, other compounds of the formulae (1), (2), (3), (4) and (5) having other variants of the proposed substituents are also customary. All these substances are obtainable by methods which are known from the literature or analogously thereto.

Besides the compounds of the general formulae (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X) and/or (XI) according to the invention, the media according to the invention preferably comprise one or more compounds from groups A, B and/or C. The proportions by weight of the compounds from these groups in the media according to the invention are:

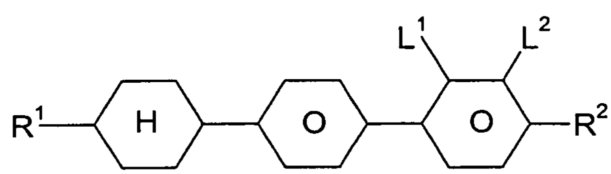
group A: from 0 to 90%, preferably from 20 to 90%, in particular from 30 to 90%

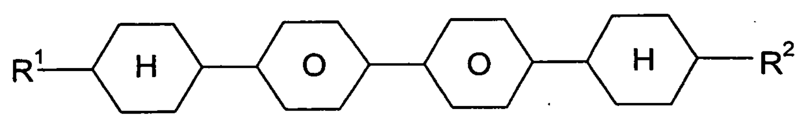
group B: from 0 to 80%, preferably from 10 to 80%, in particular from 10 to 70%

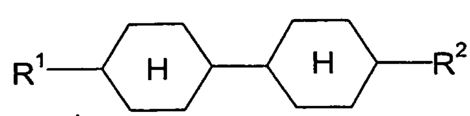
group C: from 0 to 80%, preferably from 5 to 80%, in particular from 5 to 50%.

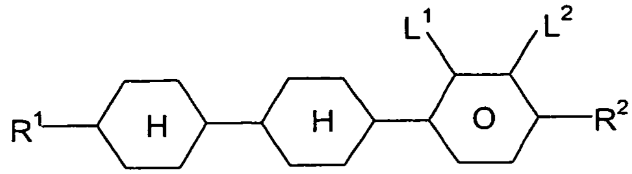
The media according to the invention preferably comprise from 1 to 40%, particularly preferably from 5 to 30%, of the compounds of the formulae (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X) and/or (XI) according to the invention. Preference is furthermore given to media comprising more than 40%, in particular from 45 to 90%, of compounds of the formulae (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X) and/or (XI) according to the invention. The media preferably comprise three, four or five compounds of the formulae (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X) and/or (XI) according to the invention.

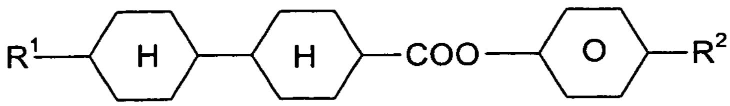
Examples of the compounds of the formulae (1), (2), (3), (4) and (5) are the compounds listed below:

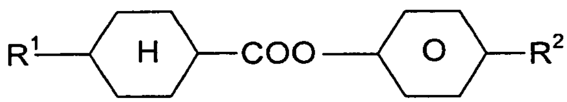


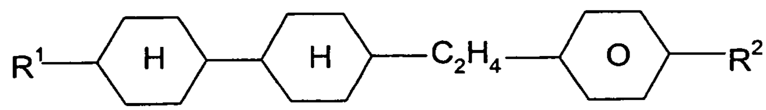


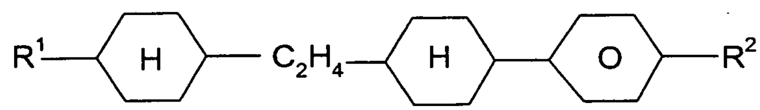


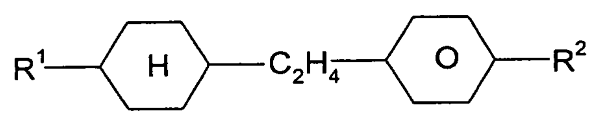


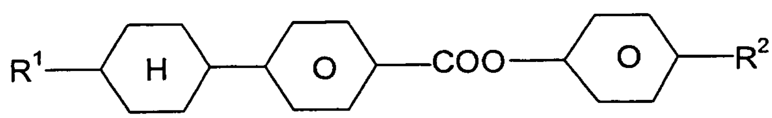


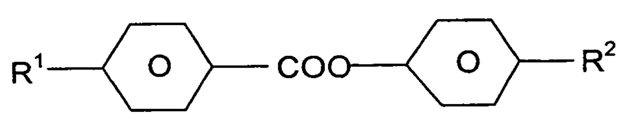


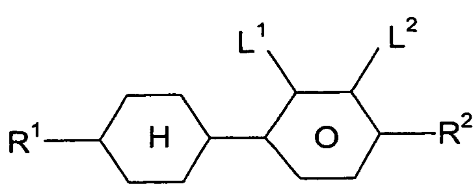


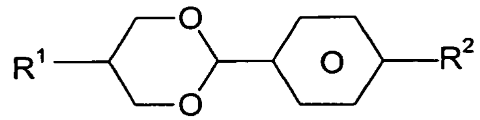


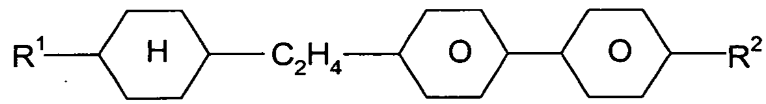


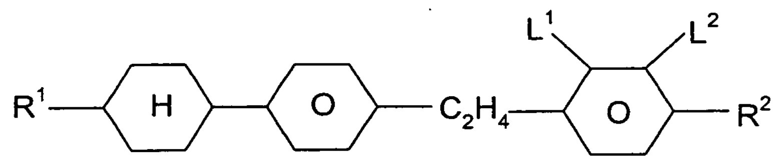


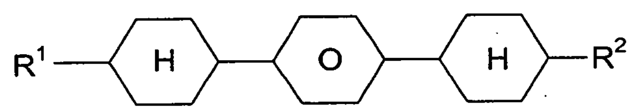


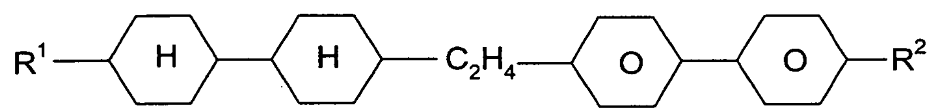


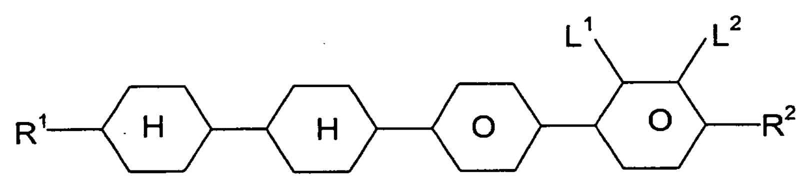


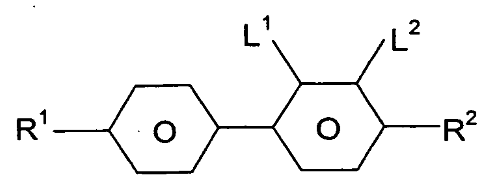




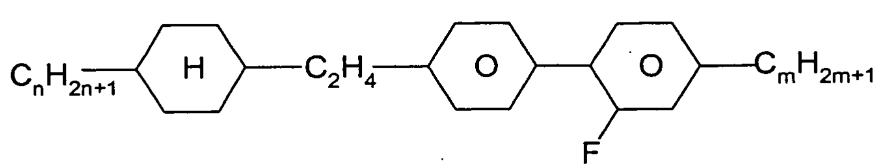


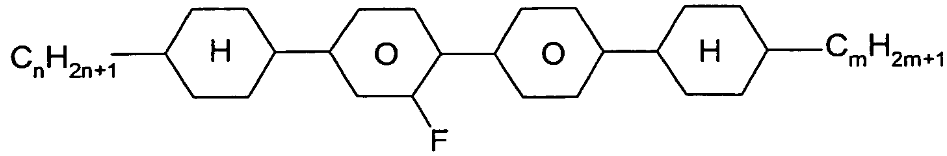


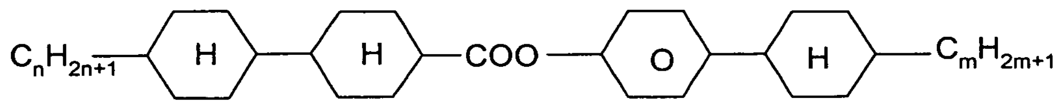


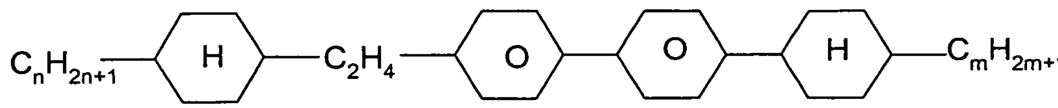


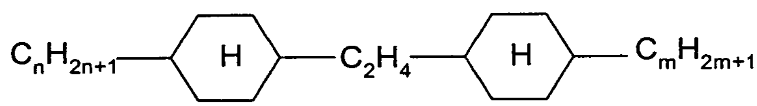
where R^1, R^2, independently of one another, $-C_nH_{2n+1}$ or $-OC_nH_{2n+1}$, and $n = 1$ to 8, and L^1, L^2, independently of one another, -H or -F,

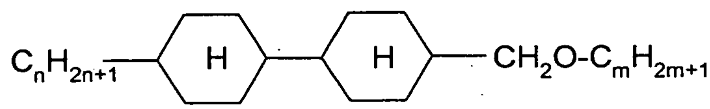


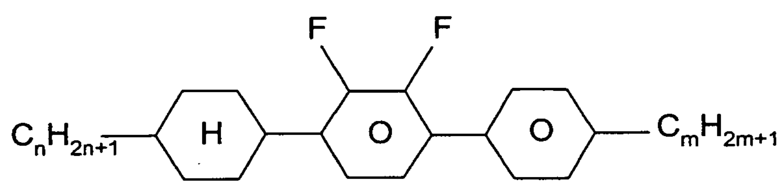


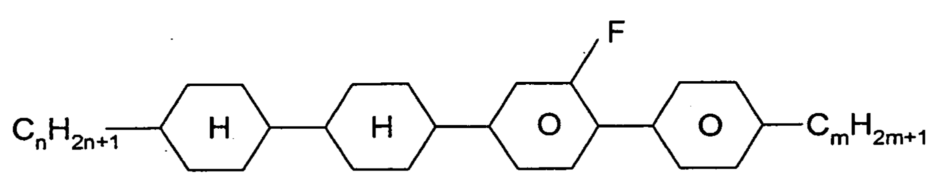


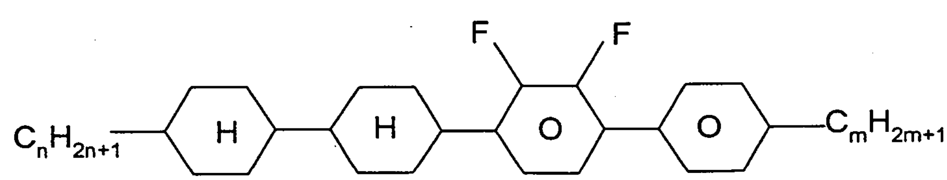


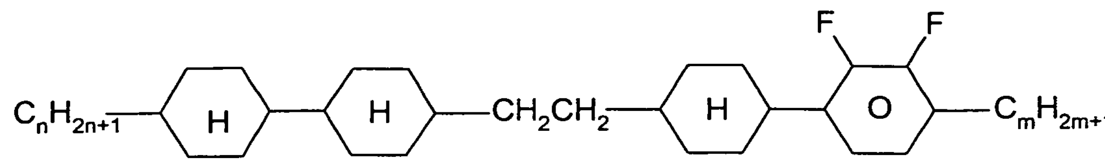


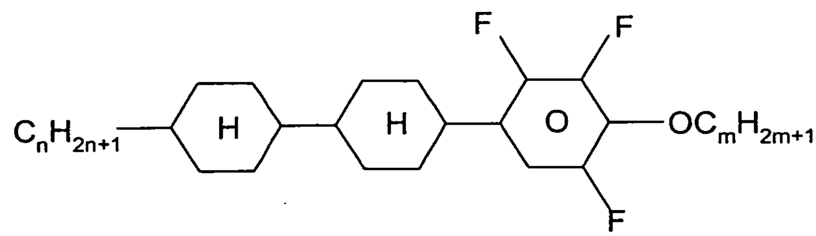


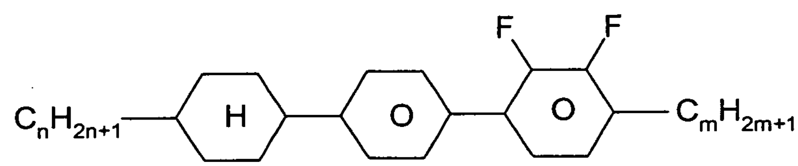












where m, n, independently of one another, from 1 to 8.

The media according to the invention are prepared in a manner conventional per se. In general, the components are dissolved in one another, advantageously at elevated temperature. By means of suitable additives, the liquid-crystalline phases of the present invention can be modified in such a way that they can be used in all types of liquid-crystal display elements that have been disclosed hitherto. Additives of this type are known to the person skilled in the art and are described in detail in the literature (H. Kelker/R. Hatz, Handbook of Liquid Crystals, Verlag Chemie, Weinheim, 1980). For example, pleochroic dyes can be added for the preparation of coloured guest-host systems or substances can be added in order to modify the dielectric anisotropy, the viscosity and/or the orientation of the nematic phases.

Owing to their negative $\Delta\varepsilon$, the compounds of the formulae (II) to (VI) are particularly suitable for use in VA-TFT displays.

The present invention therefore also relates to electro-optical liquid-crystal display elements containing a liquid-crystalline medium according to the invention.

Owing to their high positive Δε, the compounds of the formulae (VII) to (XI) are particularly suitable for use in mesogenic control media, these control media being employed, in particular, in electro-optical light-control elements which are operated at a temperature at which the mesogenic control medium in the unaddressed state is in the isotropic phase.

The present invention therefore also relates to electro-optical light-control elements, as disclosed, for example, in DE 102 17 273 A1, which contain an electrode arrangement, at least one element for polarisation of the light and a mesogenic control medium, where the light-control element is operated at a temperature at which the mesogenic control medium in the unaddressed state is in the isotropic phase, and which are characterised in that the mesogenic control medium comprises one or more compounds of the formulae (VII) to (XI).

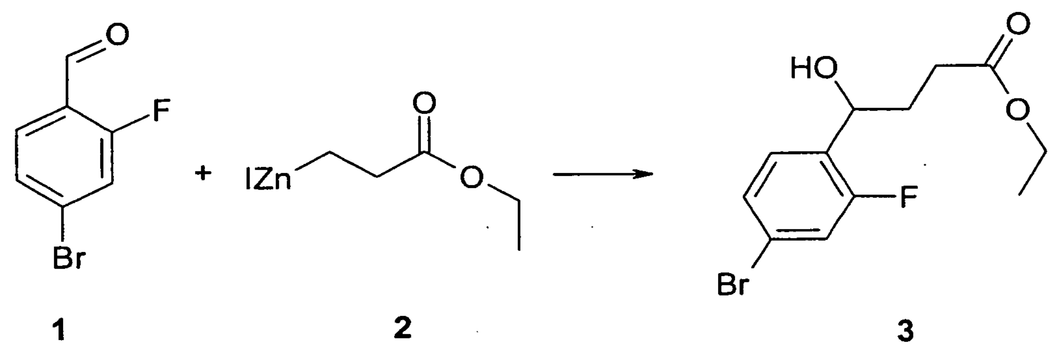
The invention is explained in greater detail below with reference to working examples, but without being restricted thereby.

Examples

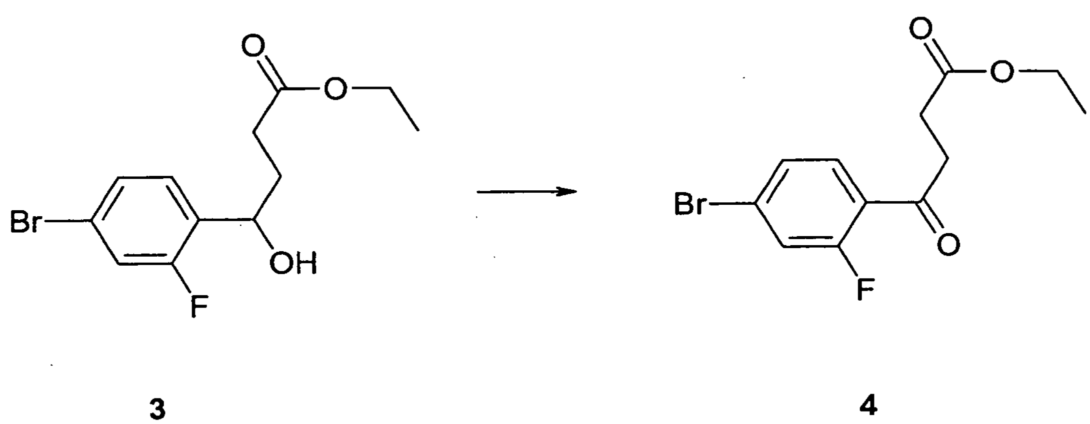
The starting substances can be obtained by generally accessible literature procedures or commercially. The reactions described are known from the literature.

A) Preparation of the naphthalene derivatives

Example 1

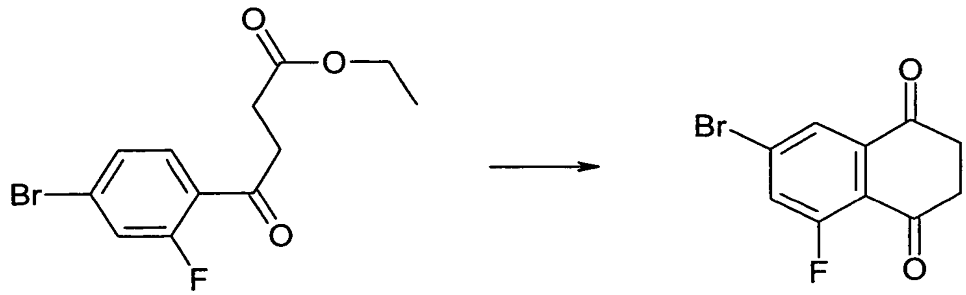


200 ml (100 mmol) of a 0.5 M solution of the zinc compound **2** in THF are added at -75°C to a solution of 20.0 g (98.5 mmol) of the aldehyde **1** in 100 ml of THF. After 30 minutes, the cooling is removed. Water is added to the thawed batch, which is acidified using 1 N HCl solution and extracted with tert-butyl methyl (MTB) ether. Drying, evaporation and chromatography on silica gel gives the hydroxy ester **3**.



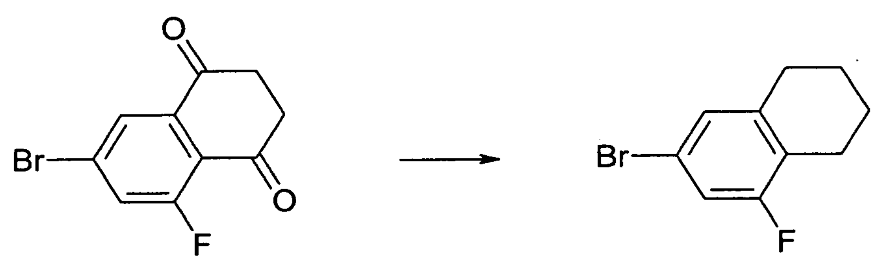
A solution of 10.0 g (32.7 mmol) of the hydroxy ester **3** is added at room temperature to a suspension of 40.0 mmol of pyridinium chlorochromate

(PCC) on 50 g of Celite® in 150 ml of dichloromethane. When the reaction is complete (TLC), the batch is filtered, and the filter cake is washed with methylene chloride. Evaporation and chromatography on silica gel gives the keto ester **4**.



4 **5**

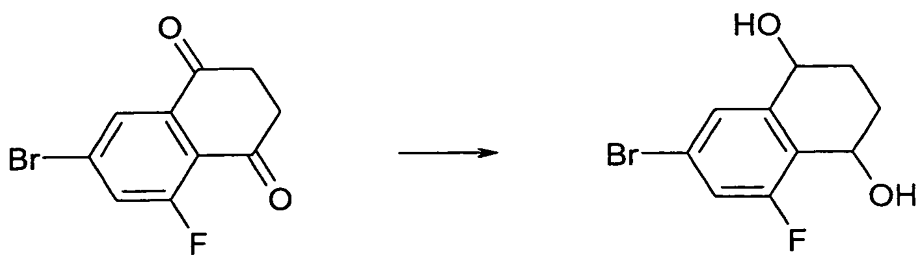
9.0 g (29.7 mmol) of the keto ester **4** are added at 60°C to 100 g of polyphosphoric acid. The temperature is subsequently increased to 120°C for 4 hours. After cooling, the batch is added to ice and extracted with tert-butyl methyl (MTB) ether. Drying, evaporation and crystallisation gives the diketone **5**.



5 **6**

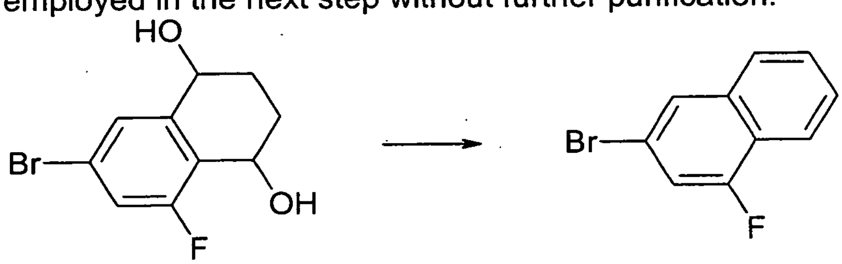
5.0 g (19.5 mmol) of the diketone **5** are dissolved in 5 ml of ethanol, 3 ml of 100% hydrazinium hydroxide and 0.5 ml of water are added, and the mixture is refluxed for 30 minutes. A solution of 800 mg of sodium in 15 ml of ethanol is subsequently added to the reaction vessel. The batch is heated at 140°C until the evolution of nitrogen is complete. 2/3 of the ethanol is subsequently distilled off. The residue is diluted with 50 ml of water and extracted with ether. The extract is washed with 10% KOH, 5% HCl and 30% sodium hydrogensulfite solution. Drying, evaporation and chromatography on silica gel gives the tetrahydronaphthalene **6**.

Example 2



5 7

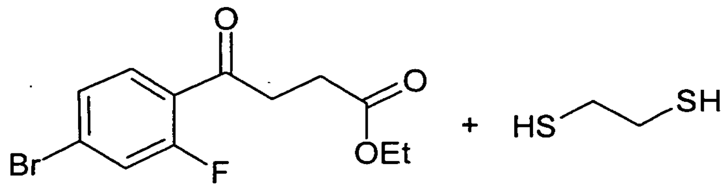
8.0 g (31.1 mmol) of the diketone **5** are dissolved in 150 ml of ethanol, and 2.4 g (65.0 mmol) of sodium borohydride are added in portions. When the reaction is complete (TLC), the batch is hydrolysed using water, the ethanol is removed under reduced pressure, and the residue is taken up in water and extracted with toluene. After evaporation, the product is employed in the next step without further purification.



7 8

10.0 g (38.3 mmol) of the diol **7** are dissolved in 200 ml of toluene, 1 g of p-toluenesulfonic acid is added, and the mixture is refluxed until the separation of water is complete. Evaporation and filtration through silica gel gives the naphthalene derivative **8**.

Example 3



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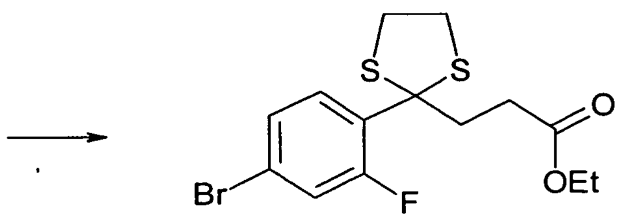
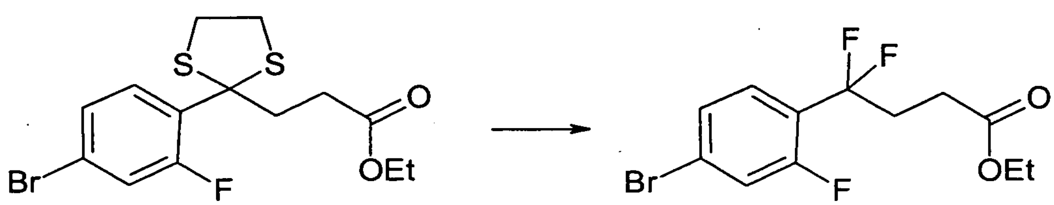


9

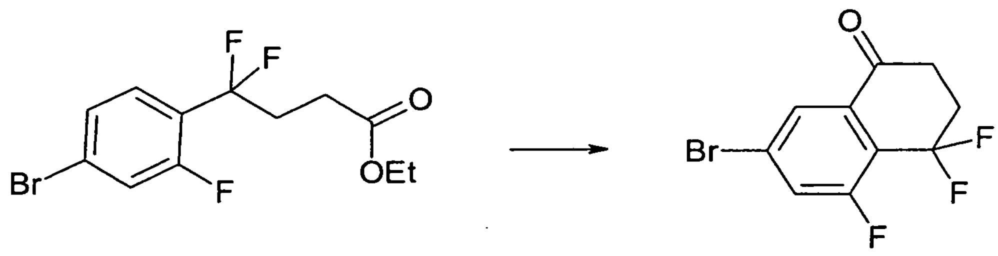
30 ml of boron trifluoride/diethyl ether complex are added under nitrogen to a solution of 15.0 g (49.5 mmol) of the keto ester **4** and 8.4 ml (100 mmol) of the dithiol in 150 ml of dichloromethane, and the mixture is stirred overnight. The batch is slowly added to saturated sodium hydrogen-carbonate solution and deacidified. Drying, evaporation and chromatography on silica gel gives the protected ketone **9**.



9 **10**

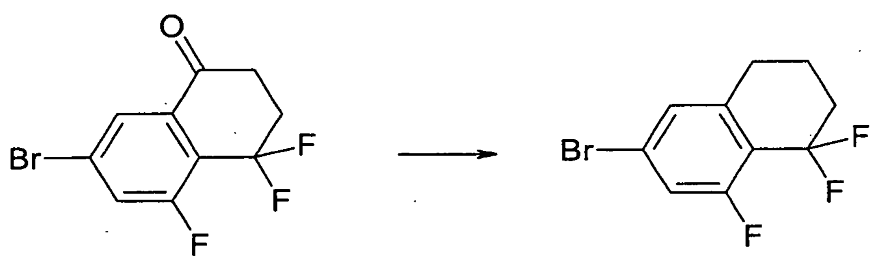
A solution of 10 g (26.4 mmol) of the protected ketone **9** in 60 ml of di-chloromethane is added at -75°C to a suspension of 30.2 g (105.2 mmol) of 1,3-dibromo-5,5-dimethylhydantoin in 60 ml of dichloromethane and 120 ml of a 65% solution of hydrogen fluoride in pyridine. The batch is slowly warmed to 0°C over the course of 3 hours and added to 1500 ml of ice-cooled 2 N sodium hydroxide solution to which 120 ml of a 39%

sodium hydrogensulfite solution have been added. The pH is adjusted to 8, and the aqueous phase is extracted with methylene chloride. Drying, evaporation and chromatography on silica gel gives the fluorinated ester **10**.



10 **11**

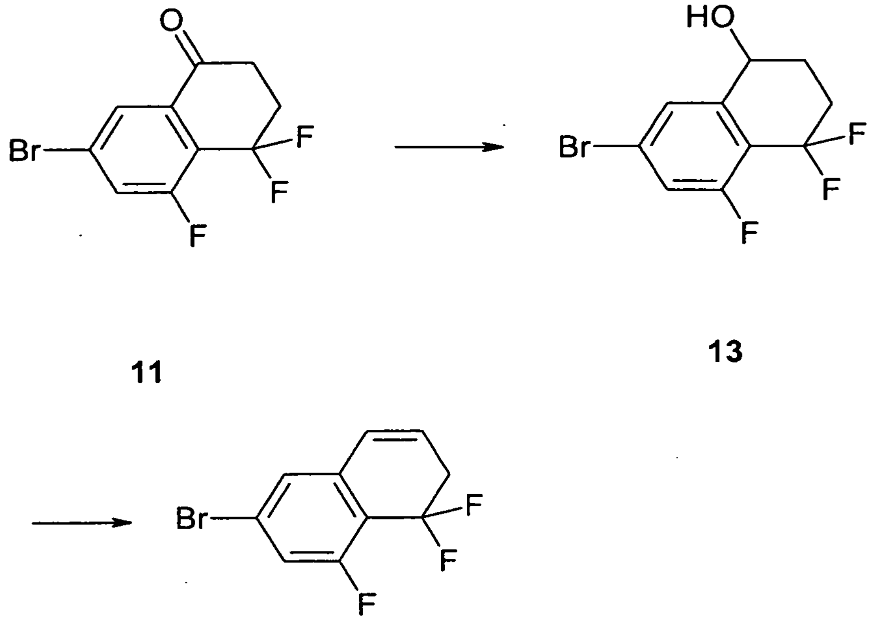
Ring closure of the fluorinated ester **10** to give compound **11** is carried out as described in Example 1.



11 **12**

Reduction to the alkane **12** is carried out as described in Example 1.

Example 4

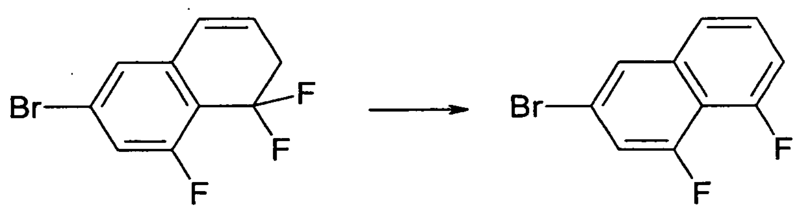


11 13

14

Reduction of compound **11** to the alcohol **13** and subsequent elimination of water to give the dihydronaphthalene derivative **14** are carried out as described in Example 2.

Example 5

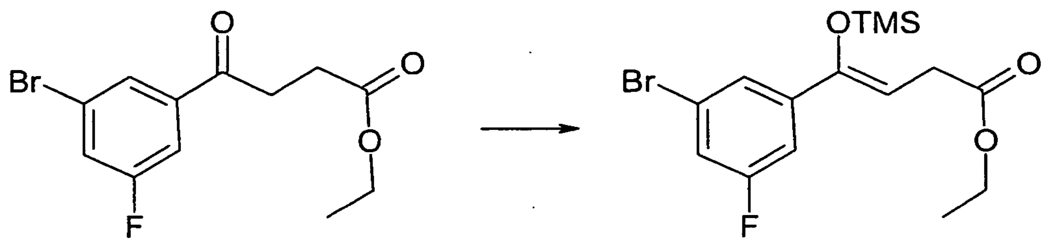


14 15

A solution of 9 g (34.2 mmol) of the dihydronaphthalene derivative **14** in 50 ml of THF is slowly added to a suspension of 4.5 g (40.1 mmol) of potassium tert-butoxide in 50 ml of THF, and the mixture is subsequently refluxed overnight. The cooled batch is diluted with water and extracted

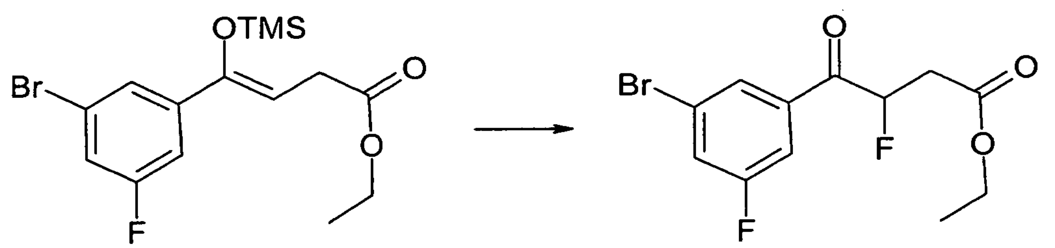
with diethyl ether. Drying, evaporation and chromatography on silica gel gives the naphthalene **15**.

Example 6



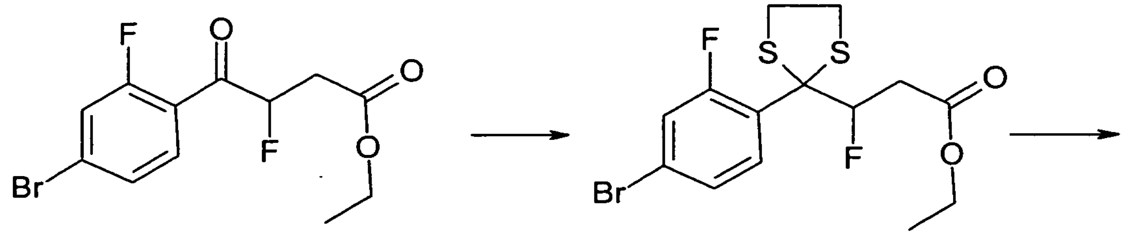
4 **16**

22 ml of a 2 M lithium diisopropylamide (LDA) solution are added at -78°C to a solution of 6.8 g (21.4 mmol) of the keto ester **4** in 80 ml of THF. After 1 hour, 2.6 g (24.0 mmol) of chlorotrimethylsilane are added. After thawing, the solvents are removed under reduced pressure, and the residue is employed in the subsequent step without further purification.

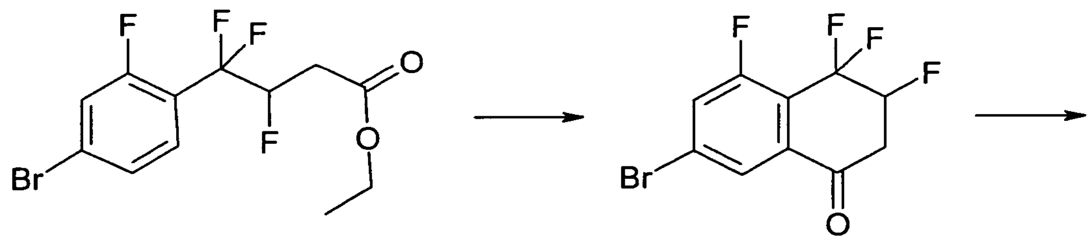


16 **17**

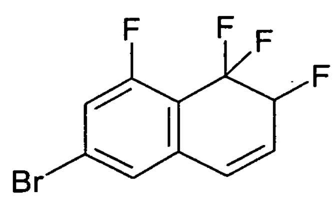
4.9 g (19.8 mmol) of N-fluoropyridinium triflate are added to a solution of 5 g of the crude enol ether **16**, and the mixture is refluxed overnight. The solvent is removed under reduced pressure, and the residue is purified by chromatography on silica gel, giving the fluorinated product **17**.



17 **18**



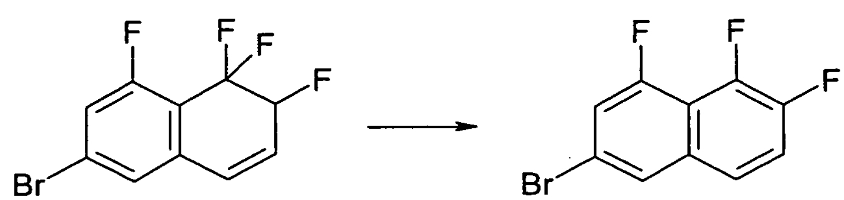
19 **20**



21

The conversions of the fluorinated product **17** into the dihydronaphthalene derivative **21** are carried out as already described in Examples 3 and 4.

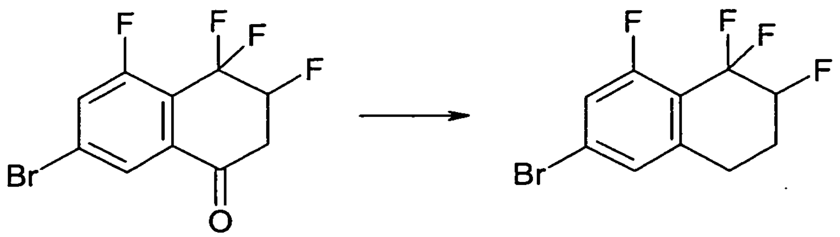
<u>Example 7</u>



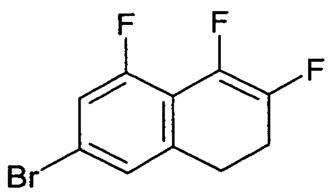
21 **22**

The conversion of the dihydronaphthalene derivative **21** into the naphthalene derivative **22** is carried out as already described in Example 5.

Example 8



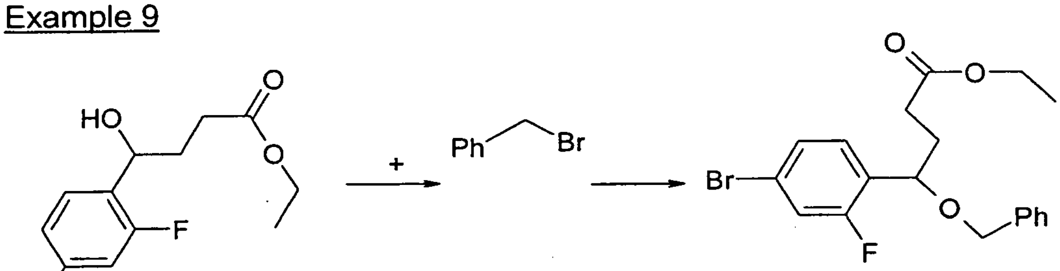
20 23



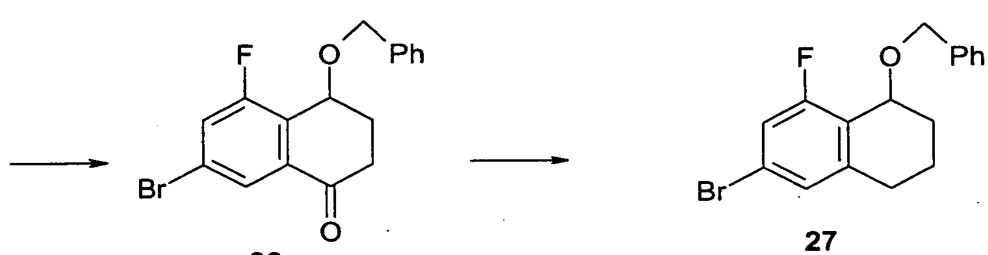
24

The conversion of compound **20** into the dihydronaphthalene derivative **24** is carried out as already described in Examples 4 and 5.

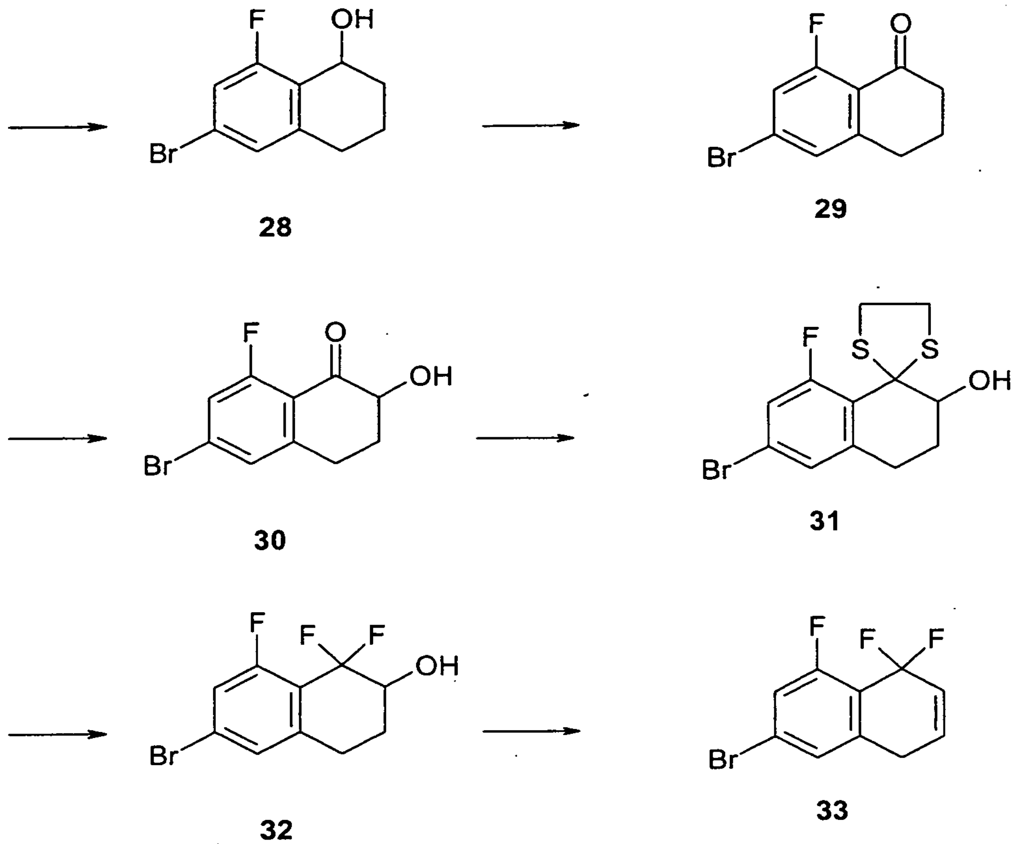
Example 9



3 25



26 27



The hydroxy ester **3** is reacted with benzyl bromide in dimethylformamide (DMF) in the presence of potassium carbonate for four hours at 120°C. After cooling, the batch is added to ice-water and extracted with tert-butyl methyl (MTB) ether. Drying, evaporation and crystallisation gives the ester **25**.

The conversion of the ester **25** into the ketone **26** and the reduction thereof to the ether **27** takes place as described in Example 1.

The ether **27** dissolved in THF is reacted on palladium/carbon catalyst in a hydrogen atmosphere. Evaporation and chromatography on silica gel gives the hydroxyl compound **28**.

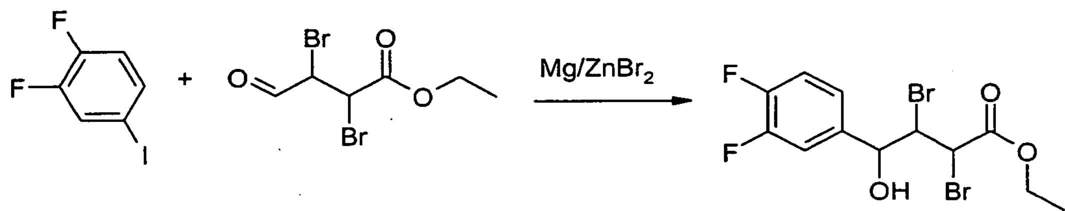
The conversion of the hydroxyl compound **28** into the ketone **29** is carried out as described in Example 1.

The ketone **29** is reacted with iodobenzene diacetate and KOH in methanol for four hours at from 0 to 20°C, giving the hydroxy ketone **30**.

The conversion of the hydroxy ketone **30** into the dithiolane **31** and the conversion thereof into the fluorinated hydroxyl compound **32** take place as described in Example 3.

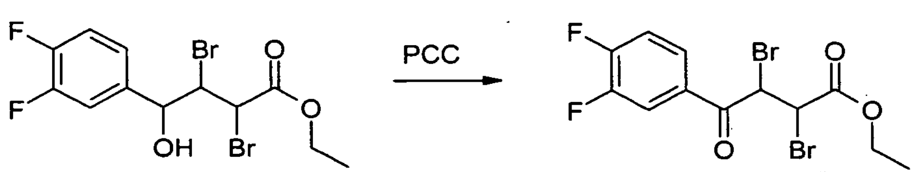
The fluorinated hydroxyl compound **32** is mixed with pyridine and $POCl_3$ with ice cooling. Alcohol is subsequently added. The reaction is carried out for four hours at 60°C. After cooling, the batch is added to ice-water and extracted with tert-butyl methyl (MTB) ether. Drying, evaporation and crystallisation gives the unsaturated fluorinated compound **33**.

<u>Example 10</u>



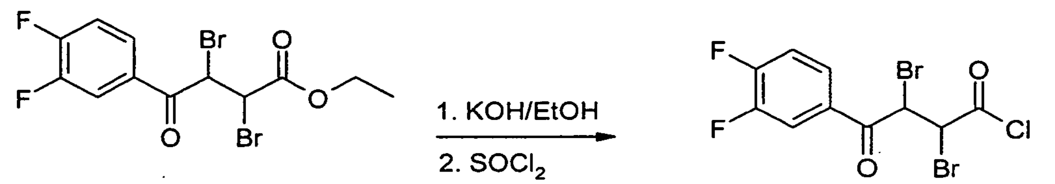
34 **35** **36**

48.0 g (200 mmol) of the aromatic compound **34**, 4.8 g (200 mmol) of magnesium and 200 ml of toluene/THF (4:1) are used to prepare the corresponding Grignard compound. 22.5 g (100 mmol) of zinc bromide are subsequently introduced. After 1 hour, 57.6 g (200 mmol) of the aldehyde **35** in 50 ml of solvent are added. After a further 2 hours, water is added to the batch, and the latter is acidified with dil. HCl solution. The aqueous phase is extracted three times with MTB ether. Drying, evaporation and chromatography gives 60.4 g of the ester **36**.

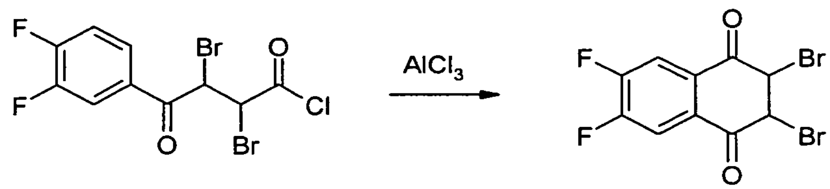


36 **37**

A solution of 50 g (124 mmol) of the ester **36** in 100 ml of dichloromethane is added at room temperature to a suspension of 40.0 g (186 mmol) of pyridinium chlorochromate (PCC) and 80 g of Celite in 300 ml of dichloromethane, and the mixture is stirred until conversion is complete (TLC). Filtration, evaporation and chromatography gives 47.1 g of the oxo ester **37**.



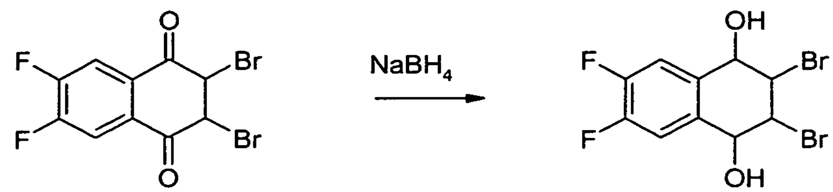
37 **38**



38 **39**

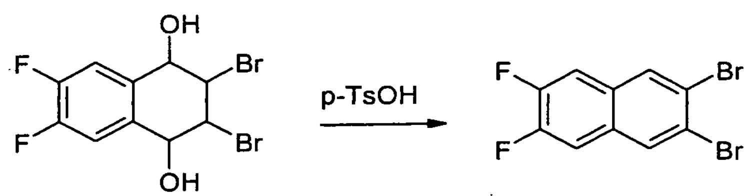
45 g (113 mol) of the ester **37** are refluxed for 20 hours with a solution of 20 g of potassium hydroxide in 50 ml of water and 150 ml of ethanol. The alcohol is subsequently removed, and the residue is taken up with water and acidified using HCl solution. The aqueous phase is extracted three times with MTB ether. The organic phase is dried and evaporated. 20 ml of thionyl chloride are added to the residue, and the mixture is refluxed until the evolution of gas is complete. Excess thionyl chloride is distilled off, and the residue is employed in the next step without further purification.

A solution of the acid chloride **38** in 50 ml of dichloromethane is added at -25°C to a suspension of 18.0 g (136 mmol) of aluminium chloride in 50 ml of dichloromethane. The batch is held at a temperature below -12°C until conversion is complete (TLC). The reaction is subsequently terminated by careful addition of water (50 ml). The precipitated solid is dissolved by means of HCl solution. The aqueous phase is extracted twice with dichloromethane, and the organic phase is dried and evaporated. Chromatography gives 30.2 g of the diketone **39**.



39 40

30.0 g (84.8 mmol) of the diketone **39** are dissolved in 150 ml of ethanol, and 6.3 g (170 mmol) of sodium borohydride are added in portions. When the reaction is complete (TLC), the batch is hydrolysed using water, the ethanol is removed under reduced pressure, and the residue is taken up in water and extracted with toluene. After evaporation, the product is employed in the next step without further purification.

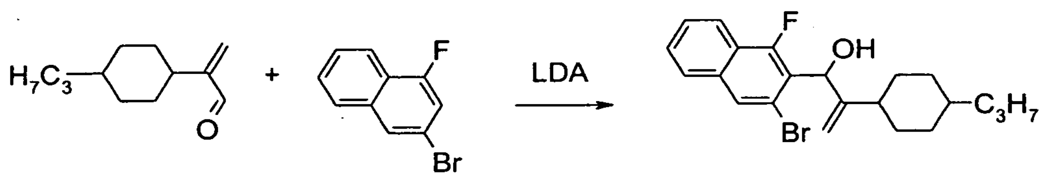


40 41

The crude diol **40** is dissolved in 200 ml of toluene, 2 g of *p*-toluenesulfonic acid are added, and the mixture is refluxed until the separation of water is complete. Evaporation and filtration through silica gel gives 24.7 g of the naphthalene **41**.

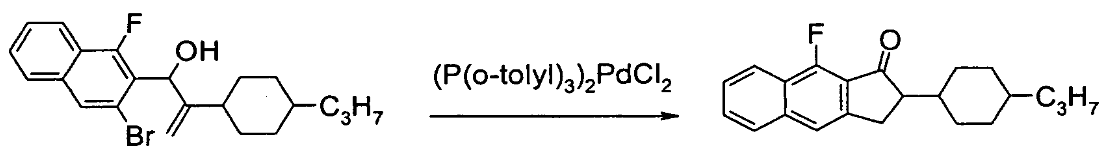
B) Preparation of the cyclopenta[b]naphthalene derivatives

Example 11



42 7 43

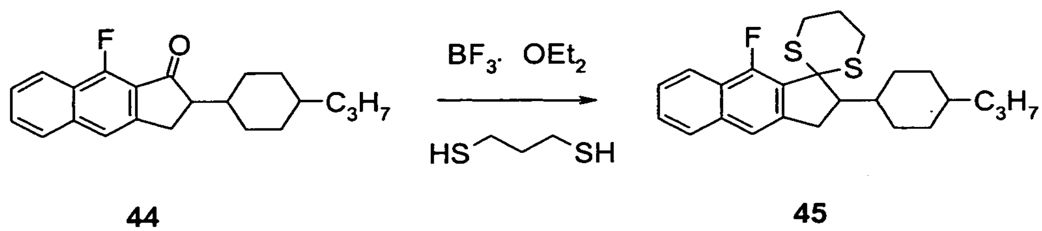
A solution of 13.5 g (60.0 mmol) of the bromofluoronaphthalene **7** in 10 ml of THF is added at -75°C to 27.0 ml of a solution, diluted with 100 ml of THF, of 2 N lithium diisopropylamide (LDA) in cyclohexane/ethylbenzene/ THF (52.4 mmol). After 2 hours at the low temperature, 8.5 g (47.3 mmol) of the aldehyde **42** in 10 ml of THF are added. After 30 minutes, the cooling is removed, and 100 ml of 1 N HCl are added to the batch at 20°C. Extraction of the aqueous phase, drying of the organic phase, evaporation and chromatography gives the allyl alcohol **43**.



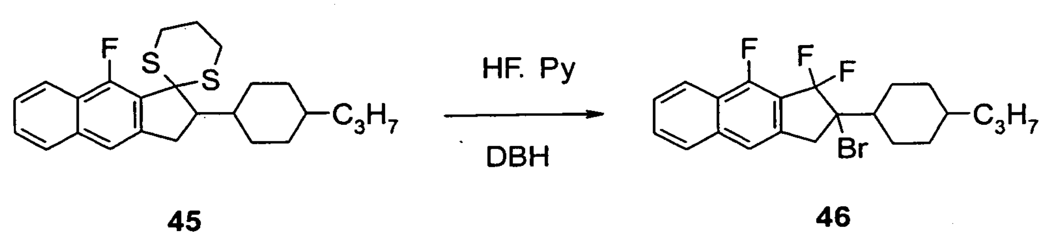
43 44

35.0 g (86.6 mmol) of the allyl alcohol **43**, 5.5 g of bis(tri-*o*-tolylphosphine)-palladium dichloride and 50 ml of triethylamine are dissolved in 390 ml of acetonitrile, and the mixture is warmed at 90°C until the allyl alcohol has reacted completely. The cooled batch is added to water. Extraction, drying, evaporation and chromatography gives the ketone **44**.

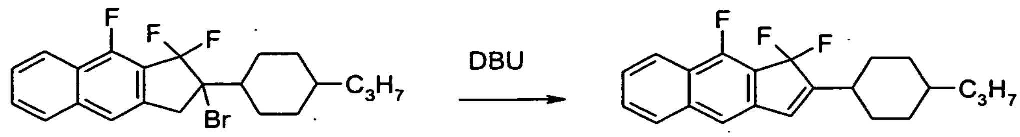
Example 12



10.0 g (30.8 mmol) of the ketone **44** and 3.2 ml (31.0 mmol) of propanedithiol are dissolved in 50 ml of dichloromethane, and 7.0 ml of boron trifluoride/diethyl ether complex are added at from 6 to 7°C, and the mixture is subsequently stirred overnight at room temperature. The batch is added to 10 ml of saturated sodium hydrogencarbonate solution and stirred until the evolution of gas is complete. After extraction of the aqueous phase, drying of the organic phase, evaporation and filtration through silica gel, the resultant residue is employed in the next step without further purification.



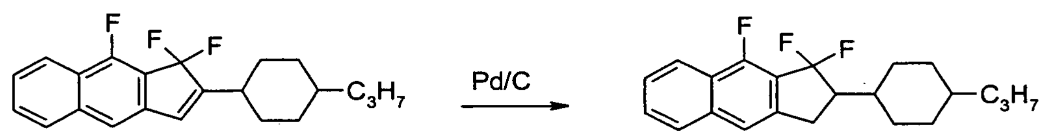
10.0 g of the crude thioketal **45** dissolved in 30 ml of dichloromethane are slowly added at -75°C to a mixture of 28.6 g (100 mmol) of 1,3-dibromo-5,5-dimethylhydantoin (DBH), 80 ml of a 65% solution of hydrogen fluoride in pyridine and 50 ml of dichloromethane. The batch is subsequently stirred overnight at room temperature. The reaction mixture is added to ice-cooled hydrogen sulfite solution and deacidified using saturated sodium hydrogencarbonate solution and sodium hydroxide solution. Extraction, drying, evaporation, re-washing with water, chromatography and crystallisation from hexane gives the cyclopenta[b]naphthalene derivative **46**.



46 47

6.0 g (14.1 mmol) of the cyclopenta[b]naphthalene derivative **46** are dissolved in 50 ml of dichloromethane, 2.4 ml (16.0 mmol) of 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) are added, and the mixture is stirred at room temperature until the starting material has reacted completely. The batch is washed with water and saturated sodium chloride solution, evaporated and subjected to chromatography. The cyclopenta[b]naphthalene derivative **47** is isolated.

Example 13



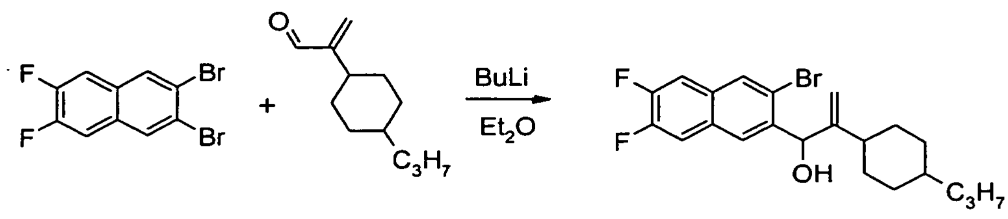
47 48

4.0 g (11.6 mmol) of the cyclopenta[b]naphthalene derivative **47** are dissolved in 50 ml of THF and hydrogenated at room temperature and atmospheric pressure on a palladium catalyst. Evaporation, chromatography on silica gel and crystallisation gives the cyclopenta[b]naphthalene derivative **48**.

The Δn and $\Delta\varepsilon$ values of the compound according to the invention were obtained by extrapolation from liquid-crystalline mixtures consisting of 5% of the compound according to the invention and 95% of one of the two commercially available liquid-crystal mixtures ZLI 4792 and ZLI 2857 (Merck, Darmstadt).

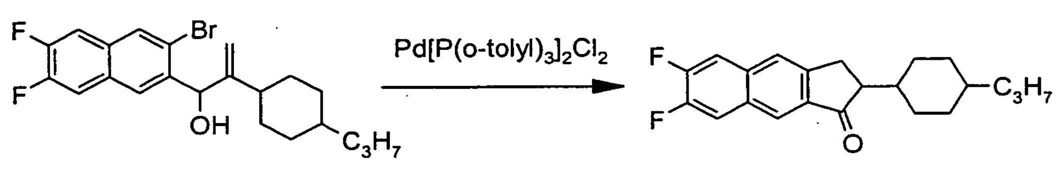
Δn:	0.1418 (ZLI 4792, 589 nm, 20°C)
$\Delta\varepsilon$:	-4.9 (ZLI 2857, 1 kHz, 20°C)
Clearing point:	158.6°C (ZLI 4792)

Example 14



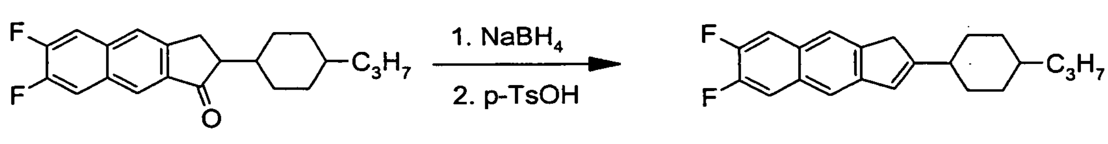
41 **49** **50**

38.0 ml of an *n*-butyllithium solution in *n*-hexane are added at -75°C to a solution of 20.0 g (62.1 mmol) of the naphthalene **41** in 100 ml of diethyl ether, and the mixture is stirred for 1 hour. 11.2 g (62.1 mmol) of the aldehyde **49** in 50 ml of diethyl ether are subsequently added, and the mixture is stirred overnight. Water is added to the batch. The aqueous phase is extracted with diethyl ether, and the organic phase is dried and evaporated. Chromatography gives 21.2 g of the allyl alcohol **50**.



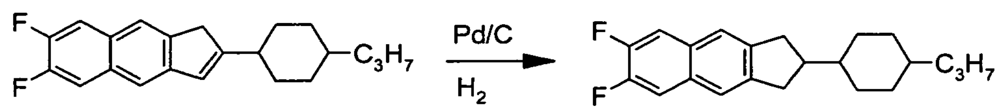
50 **51**

20.0 g (47.2 mmol) of the allyl alcohol **50** are dissolved in 175 ml of acetonitrile and 25 ml of triethylamine, 2.5 g of bis-tri-*o*-tolylphosphinepalladium(II) chloride are added, and the mixture is warmed at 90°C until the starting material has disappeared (HPLC). The batch is subsequently added to saturated sodium chloride solution. Extraction with MTB ether, drying, evaporation and chromatography on silica gel gives 10.5 g of the ketone **51**.



51 **52**

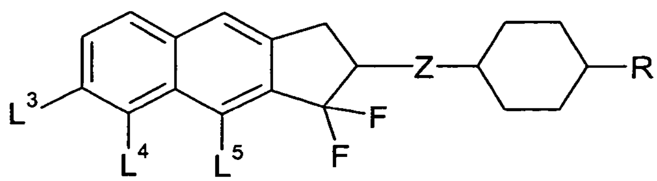
10.0 g (29.2 mmol) of the ketone **51** are dissolved in 75 ml of ethanol, and 3.2 g (86 mmol) of sodium borohydride are added in portions. When the reaction is complete (TLC), the batch is hydrolysed using water, the ethanol is removed under reduced pressure, and the residue is taken up in water and extracted with toluene. After evaporation, the product is employed in the next step without further purification. The crude alcohol is dissolved in 100 ml of toluene, 1 g of *p*-toluenesulfonic acid is added, and the mixture is refluxed until the separation of water is complete. Evaporation and filtration through silica gel gives 8.5 of the naphthalene **52**.



8.0 g (25.5 mmol) of the naphthalene **52** are dissolved in 50 ml of THF and hydrogenated on a palladium catalyst. Evaporation and chromatography on silica gel gives 7.9 g of the hydrogenated substance **53**.

The following compounds are prepared analogously to Examples 1 to 14 or analogously to known synthetic steps:

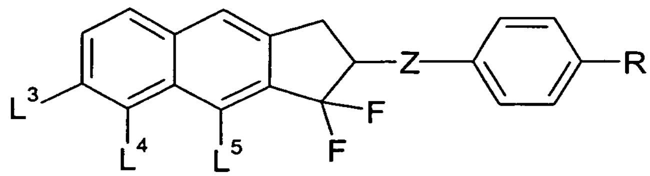
Examples 15 to 29



Example	L^3	L^4	L^5	Z	R
15	H	H	F	Bd.	CH_3
16	H	F	F	Bd.	C_2H_5
17	H	F	F	Bd.	C_3H_7
18	F	F	F	Bd.	C_3H_7
19	F	F	F	Bd.	C_4H_9
20	OC_2H_5	F	F	Bd.	C_3H_7
21	OC_2H_5	F	F	Bd.	C_5H_{11}
22	H	H	F	$-CF_2CF_2-$	CH_3
23	H	H	F	$-CF_2CF_2-$	C_3H_7
24	H	F	F	$-CF_2CF_2-$	C_2H_5
25	H	F	F	$-CF_2CF_2-$	C_3H_7
26	F	F	F	$-CF_2CF_2-$	C_3H_7
27	F	F	F	$-CF_2CF_2-$	C_4H_9
28	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
29	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

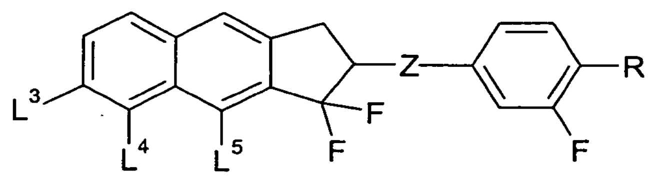
<u>Examples 30 to 53</u>



Example	L^3	L^4	L^5	Z	R
30	H	H	F	Bd.	CH_3
31	H	H	F	Bd.	C_3H_7
32	H	F	F	Bd.	C_2H_5
33	H	F	F	Bd.	C_3H_7
34	F	F	F	Bd.	C_3H_7
35	F	F	F	Bd.	C_4H_9
36	OC_2H_5	F	F	Bd.	C_3H_7
37	OC_2H_5	F	F	Bd.	C_5H_{11}
38	H	H	F	$-CF_2O-$	CH_3
39	H	H	F	$-CF_2O-$	C_3H_7
40	H	F	F	$-CF_2O-$	C_2H_5
41	H	F	F	$-CF_2O-$	C_3H_7
42	F	F	F	$-CF_2O-$	C_3H_7
43	F	F	F	$-CF_2O-$	C_4H_9
44	OC_2H_5	F	F	$-CF_2O-$	C_3H_7
45	OC_2H_5	F	F	$-CF_2O-$	C_5H_{11}
46	H	H	F	$-CF_2CF_2-$	CH_3
47	H	H	F	$-CF_2CF_2-$	C_3H_7
48	H	F	F	$-CF_2CF_2-$	C_2H_5
49	H	F	F	$-CF_2CF_2-$	C_3H_7
50	F	F	F	$-CF_2CF_2-$	C_3H_7
51	F	F	F	$-CF_2CF_2-$	C_4H_9
52	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
53	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

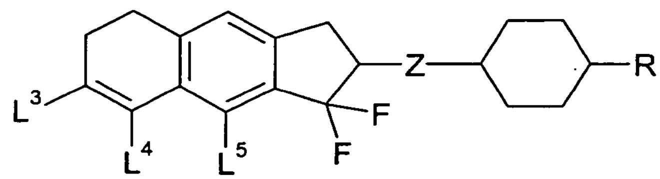
Examples 54 to 77



Example	L^3	L^4	L^5	Z	R
54	H	H	F	Bd.	CH_3
55	H	H	F	Bd.	C_3H_7
56	H	F	F	Bd.	C_2H_5
57	H	F	F	Bd.	C_3H_7
58	F	F	F	Bd.	C_3H_7
59	F	F	F	Bd.	C_4H_9
60	OC_2H_5	F	F	Bd.	C_3H_7
61	OC_2H_5	F	F	Bd.	C_5H_{11}
62	H	H	F	$-CF_2O-$	CH_3
63	H	H	F	$-CF_2O-$	C_3H_7
64	H	F	F	$-CF_2O-$	C_2H_5
65	H	F	F	$-CF_2O-$	C_3H_7
66	F	F	F	$-CF_2O-$	C_3H_7
67	F	F	F	$-CF_2O-$	C_4H_9
68	OC_2H_5	F	F	$-CF_2O-$	C_3H_7
69	OC_2H_5	F	F	$-CF_2O-$	C_5H_{11}
70	H	H	F	$-CF_2CF_2-$	CH_3
71	H	H	F	$-CF_2CF_2-$	C_3H_7
72	H	F	F	$-CF_2CF_2-$	C_2H_5
73	H	F	F	$-CF_2CF_2-$	C_3H_7
74	F	F	F	$-CF_2CF_2-$	C_3H_7
75	F	F	F	$-CF_2CF_2-$	C_4H_9
76	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
77	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

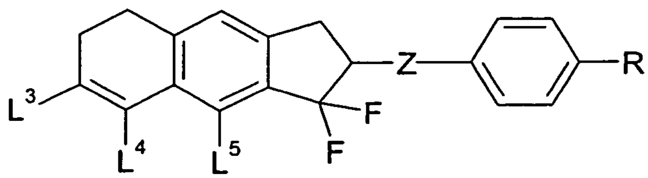
Examples 78 to 93



Example	L^3	L^4	L^5	Z	R
78	H	H	F	Bd.	CH_3
79	H	H	F	Bd.	C_3H_7
80	H	F	F	Bd.	C_2H_5
81	H	F	F	Bd.	C_3H_7
82	F	F	F	Bd.	C_3H_7
83	F	F	F	Bd.	C_4H_9
84	OC_2H_5	F	F	Bd.	C_3H_7
85	OC_2H_5	F	F	Bd.	C_5H_{11}
86	H	H	F	$-CF_2CF_2-$	CH_3
87	H	H	F	$-CF_2CF_2-$	C_3H_7
88	H	F	F	$-CF_2CF_2-$	C_2H_5
89	H	F	F	$-CF_2CF_2-$	C_3H_7
90	F	F	F	$-CF_2CF_2-$	C_3H_7
91	F	F	F	$-CF_2CF_2-$	C_4H_9
92	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
93	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

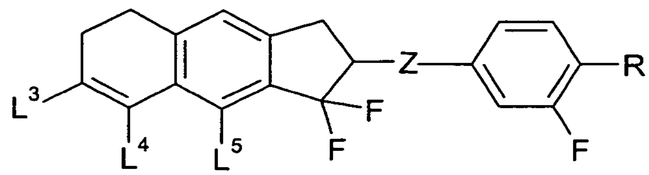
Examples 94 to 117



Example	L^3	L^4	L^5	Z	R
94	H	H	F	Bd.	CH_3
95	H	H	F	Bd.	C_3H_7
96	H	F	F	Bd.	C_2H_5
97	H	F	F	Bd.	C_3H_7
98	F	F	F	Bd.	C_3H_7
99	F	F	F	Bd.	C_4H_9
100	OC_2H_5	F	F	Bd.	C_3H_7
101	OC_2H_5	F	F	Bd.	C_5H_{11}
102	H	H	F	$-CF_2O-$	CH_3
103	H	H	F	$-CF_2O-$	C_3H_7
104	H	F	F	$-CF_2O-$	C_2H_5
105	H	F	F	$-CF_2O-$	C_3H_7
106	F	F	F	$-CF_2O-$	C_3H_7
107	F	F	F	$-CF_2O-$	C_4H_9
108	OC_2H_5	F	F	$-CF_2O-$	C_3H_7
109	OC_2H_5	F	F	$-CF_2O-$	C_5H_{11}
110	H	H	F	$-CF_2CF_2-$	CH_3
111	H	H	F	$-CF_2CF_2-$	C_3H_7
112	H	F	F	$-CF_2CF_2-$	C_2H_5
113	H	F	F	$-CF_2CF_2-$	C_3H_7
114	F	F	F	$-CF_2CF_2-$	C_3H_7
115	F	F	F	$-CF_2CF_2-$	C_4H_9
116	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
117	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

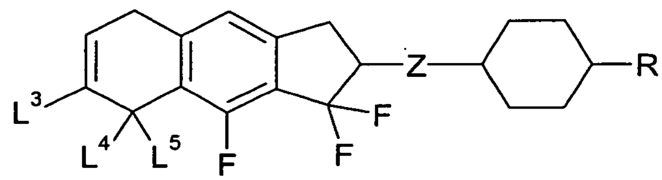
Examples 118 to 141



Example	L^3	L^4	L^5	Z	R
118	H	H	F	Bd.	CH_3
119	H	H	F	Bd.	C_3H_7
120	H	F	F	Bd.	C_2H_5
121	H	F	F	Bd.	C_3H_7
122	F	F	F	Bd.	C_3H_7
123	F	F	F	Bd.	C_4H_9
124	OC_2H_5	F	F	Bd.	C_3H_7
125	OC_2H_5	F	F	Bd.	C_5H_{11}
126	H	H	F	$-CF_2O-$	CH_3
127	H	H	F	$-CF_2O-$	C_3H_7
128	H	F	F	$-CF_2O-$	C_2H_5
129	H	F	F	$-CF_2O-$	C_3H_7
130	F	F	F	$-CF_2O-$	C_3H_7
131	F	F	F	$-CF_2O-$	C_4H_9
132	OC_2H_5	F	F	$-CF_2O-$	C_3H_7
133	OC_2H_5	F	F	$-CF_2O-$	C_5H_{11}
134	H	H	F	$-CF_2CF_2-$	CH_3
135	H	H	F	$-CF_2CF_2-$	C_3H_7
136	H	F	F	$-CF_2CF_2-$	C_2H_5
137	H	F	F	$-CF_2CF_2-$	C_3H_7
138	F	F	F	$-CF_2CF_2-$	C_3H_7
139	F	F	F	$-CF_2CF_2-$	C_4H_9
140	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
141	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

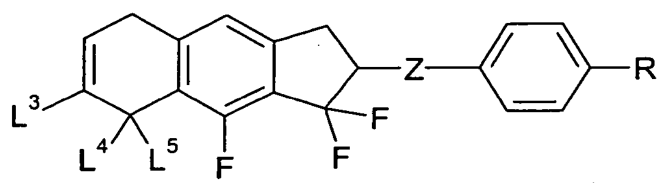
Examples 142 to 157



Example	L^3	L^4	L^5	Z	R
142	H	H	H	Bd.	CH_3
143	H	H	H	Bd.	C_3H_7
144	H	F	F	Bd.	C_2H_5
145	H	F	F	Bd.	C_3H_7
146	F	F	F	Bd.	C_3H_7
147	F	F	F	Bd.	C_4H_9
148	OC_2H_5	F	F	Bd.	C_3H_7
149	OC_2H_5	F	F	Bd.	C_5H_{11}
150	H	H	H	$-CF_2CF_2-$	CH_3
151	H	H	H	$-CF_2CF_2-$	C_3H_7
152	H	F	F	$-CF_2CF_2-$	C_2H_5
153	H	F	F	$-CF_2CF_2-$	C_3H_7
154	F	F	F	$-CF_2CF_2-$	C_3H_7
155	F	F	F	$-CF_2CF_2-$	C_4H_9
156	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
157	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

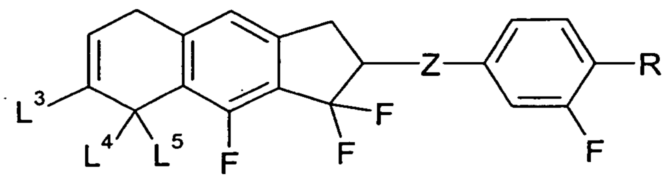
Examples 158 to 181



Example	L^3	L^4	L^5	Z	R
158	H	H	H	Bd.	CH_3
159	H	H	H	Bd.	C_3H_7
160	H	F	F	Bd.	C_2H_5
161	H	F	F	Bd.	C_3H_7
162	F	F	F	Bd.	C_3H_7
163	F	F	F	Bd.	C_4H_9
164	OC_2H_5	F	F	Bd.	C_3H_7
165	OC_2H_5	F	F	Bd.	C_5H_{11}
166	H	H	H	$-CF_2O-$	CH_3
167	H	H	H	$-CF_2O-$	C_3H_7
168	H	F	F	$-CF_2O-$	C_2H_5
169	H	F	F	$-CF_2O-$	C_3H_7
170	F	F	F	$-CF_2O-$	C_3H_7
171	F	F	F	$-CF_2O-$	C_4H_9
172	OC_2H_5	F	F	$-CF_2O-$	C_3H_7
173	OC_2H_5	F	F	$-CF_2O-$	C_5H_{11}
174	H	H	H	$-CF_2CF_2-$	CH_3
175	H	H	H	$-CF_2CF_2-$	C_3H_7
176	H	F	F	$-CF_2CF_2-$	C_2H_5
177	H	F	F	$-CF_2CF_2-$	C_3H_7
178	F	F	F	$-CF_2CF_2-$	C_3H_7
179	F	F	F	$-CF_2CF_2-$	C_4H_9
180	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
181	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

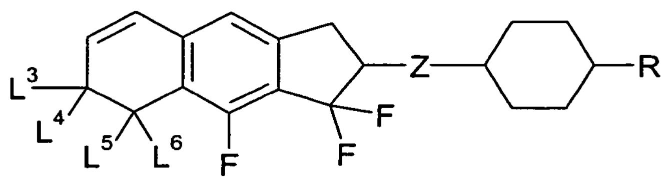
Examples 182 to 205



Example	L^3	L^4	L^5	Z	R
182	H	H	H	Bd.	CH_3
183	H	H	H	Bd.	C_3H_7
184	H	F	F	Bd.	C_2H_5
185	H	F	F	Bd.	C_3H_7
186	F	F	F	Bd.	C_3H_7
187	F	F	F	Bd.	C_4H_9
188	OC_2H_5	F	F	Bd.	C_3H_7
189	OC_2H_5	F	F	Bd.	C_5H_{11}
190	H	H	H	$-CF_2O-$	CH_3
191	H	H	H	$-CF_2O-$	C_3H_7
192	H	F	F	$-CF_2O-$	C_2H_5
193	H	F	F	$-CF_2O-$	C_3H_7
194	F	F	F	$-CF_2O-$	C_3H_7
195	F	F	F	$-CF_2O-$	C_4H_9
196	OC_2H_5	F	F	$-CF_2O-$	C_3H_7
197	OC_2H_5	F	F	$-CF_2O-$	C_5H_{11}
198	H	H	H	$-CF_2CF_2-$	CH_3
199	H	H	H	$-CF_2CF_2-$	C_3H_7
200	H	F	F	$-CF_2CF_2-$	C_2H_5
201	H	F	F	$-CF_2CF_2-$	C_3H_7
202	F	F	F	$-CF_2CF_2-$	C_3H_7
203	F	F	F	$-CF_2CF_2-$	C_4H_9
204	OC_2H_5	F	F	$-CF_2CF_2-$	C_3H_7
205	OC_2H_5	F	F	$-CF_2CF_2-$	C_5H_{11}

Bd. = single bond

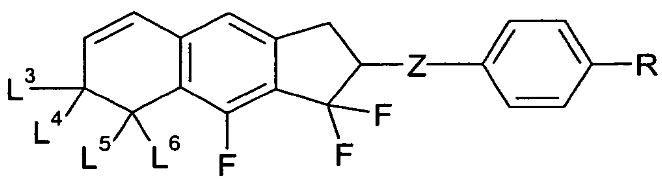
Examples 206 to 217



Example	L^3	L^4	L^5	L^6	Z	R
206	H	H	H	H	Bd.	CH_3
207	H	H	H	H	Bd.	C_3H_7
208	H	H	F	F	Bd.	C_2H_5
209	H	H	F	F	Bd.	C_3H_7
210	F	F	F	F	Bd.	C_3H_7
211	F	F	F	F	Bd.	C_4H_9
212	H	H	H	H	$-CF_2CF_2-$	CH_3
213	H	H	H	H	$-CF_2CF_2-$	C_3H_7
214	H	H	F	F	$-CF_2CF_2-$	C_2H_5
215	H	H	F	F	$-CF_2CF_2-$	C_3H_7
216	F	F	F	F	$-CF_2CF_2-$	C_3H_7
217	F	F	F	F	$-CF_2CF_2-$	C_4H_9

Bd. = single bond

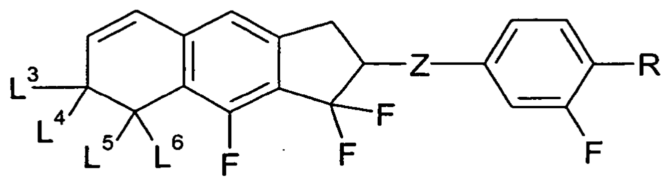
Examples 218 to 235



Example	L^3	L^4	L^5	L^6	Z	R
218	H	H	H	H	Bd.	CH_3
219	H	H	H	H	Bd.	C_3H_7
220	H	H	F	F	Bd.	C_2H_5
221	H	H	F	F	Bd.	C_3H_7
222	F	F	F	F	Bd.	C_3H_7
223	F	F	F	F	Bd.	C_4H_9
224	H	H	H	H	$-CF_2O-$	CH_3
225	H	H	H	H	$-CF_2O-$	C_3H_7
226	H	H	F	F	$-CF_2O-$	C_2H_5
227	H	H	F	F	$-CF_2O-$	C_3H_7
228	F	F	F	F	$-CF_2O-$	C_3H_7
229	F	F	F	F	$-CF_2O-$	C_4H_9
230	H	H	H	H	$-CF_2CF_2-$	CH_3
231	H	H	H	H	$-CF_2CF_2-$	C_3H_7
232	H	H	F	F	$-CF_2CF_2-$	C_2H_5
233	H	H	F	F	$-CF_2CF_2-$	C_3H_7
234	F	F	F	F	$-CF_2CF_2-$	C_3H_7
235	F	F	F	F	$-CF_2CF_2-$	C_4H_9

Bd. = single bond

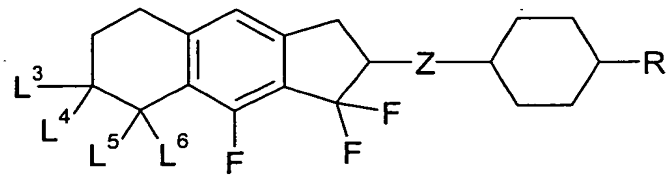
Examples 236 to 253



Example	L^3	L^4	L^5	L^6	Z	R
236	H	H	H	H	Bd.	CH_3
237	H	H	H	H	Bd.	C_3H_7
238	H	H	F	F	Bd.	C_2H_5
239	H	H	F	F	Bd.	C_3H_7
240	F	F	F	F	Bd.	C_3H_7
241	F	F	F	F	Bd.	C_4H_9
242	H	H	H	H	$-CF_2O-$	CH_3
243	H	H	H	H	$-CF_2O-$	C_3H_7
244	H	H	F	F	$-CF_2O-$	C_2H_5
245	H	H	F	F	$-CF_2O-$	C_3H_7
246	F	F	F	F	$-CF_2O-$	C_3H_7
247	F	F	F	F	$-CF_2O-$	C_4H_9
248	H	H	H	H	$-CF_2CF_2-$	CH_3
249	H	H	H	H	$-CF_2CF_2-$	C_3H_7
250	H	H	F	F	$-CF_2CF_2-$	C_2H_5
251	H	H	F	F	$-CF_2CF_2-$	C_3H_7
252	F	F	F	F	$-CF_2CF_2-$	C_3H_7
253	F	F	F	F	$-CF_2CF_2-$	C_4H_9

Bd. = single bond

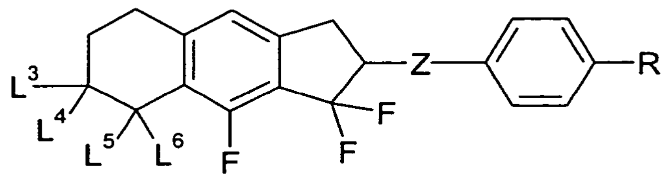
Examples 254 to 265



Example	L^3	L^4	L^5	L^6	Z	R
254	H	H	H	H	Bd.	CH_3
255	H	H	H	H	Bd.	C_3H_7
256	H	H	F	F	Bd.	C_2H_5
257	H	H	F	F	Bd.	C_3H_7
258	F	F	F	F	Bd.	C_3H_7
259	F	F	F	F	Bd.	C_4H_9
260	H	H	H	H	$-CF_2CF_2-$	CH_3
261	H	H	H	H	$-CF_2CF_2-$	C_3H_7
262	H	H	F	F	$-CF_2CF_2-$	C_2H_5
263	H	H	F	F	$-CF_2CF_2-$	C_3H_7
264	F	F	F	F	$-CF_2CF_2-$	C_3H_7
265	F	F	F	F	$-CF_2CF_2-$	C_4H_9

Bd. = single bond

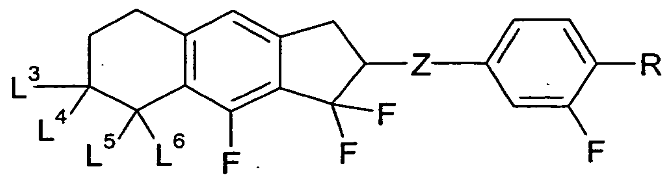
Examples 266 to 283



Example	L^3	L^4	L^5	L^6	Z	R
266	H	H	H	H	Bd.	CH_3
267	H	H	H	H	Bd.	C_3H_7
268	H	H	F	F	Bd.	C_2H_5
269	H	H	F	F	Bd.	C_3H_7
270	F	F	F	F	Bd.	C_3H_7
271	F	F	F	F	Bd.	C_4H_9
272	H	H	H	H	$-CF_2O-$	CH_3
273	H	H	H	H	$-CF_2O-$	C_3H_7
274	H	H	F	F	$-CF_2O-$	C_2H_5
275	H	H	F	F	$-CF_2O-$	C_3H_7
276	F	F	F	F	$-CF_2O-$	C_3H_7
277	F	F	F	F	$-CF_2O-$	C_4H_9
278	H	H	H	H	$-CF_2CF_2-$	CH_3
279	H	H	H	H	$-CF_2CF_2-$	C_3H_7
280	H	H	F	F	$-CF_2CF_2-$	C_2H_5
281	H	H	F	F	$-CF_2CF_2-$	C_3H_7
282	F	F	F	F	$-CF_2CF_2-$	C_3H_7
283	F	F	F	F	$-CF_2CF_2-$	C_4H_9

Bd. = single bond

Examples 284 to 301



Example	L^3	L^4	L^5	L^6	Z	R
284	H	H	H	H	Bd.	CH_3
285	H	H	H	H	Bd.	C_3H_7
286	H	H	F	F	Bd.	C_2H_5
287	H	H	F	F	Bd.	C_3H_7
288	F	F	F	F	Bd.	C_3H_7
289	F	F	F	F	Bd.	C_4H_9
290	H	H	H	H	$-CF_2O-$	CH_3
291	H	H	H	H	$-CF_2O-$	C_3H_7
292	H	H	F	F	$-CF_2O-$	C_2H_5
293	H	H	F	F	$-CF_2O-$	C_3H_7
294	F	F	F	F	$-CF_2O-$	C_3H_7
295	F	F	F	F	$-CF_2O-$	C_4H_9
296	H	H	H	H	$-CF_2CF_2-$	CH_3
297	H	H	H	H	$-CF_2CF_2-$	C_3H_7
298	H	H	F	F	$-CF_2CF_2-$	C_2H_5
299	H	H	F	F	$-CF_2CF_2-$	C_3H_7
300	F	F	F	F	$-CF_2CF_2-$	C_3H_7
301	F	F	F	F	$-CF_2CF_2-$	C_4H_9

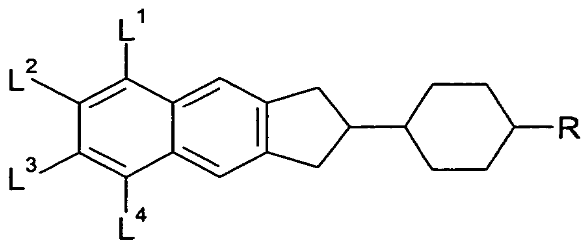
Bd. = single bond

Table 1

Δε and Δn values for substances of individual examples

Example No.	Δε	Δn
17	-6.3	0.143
18	-8.0	0.143
20	-7.3	0.166
79	-3.9	0.127
81	-9.1	0.117
82	-10.2	0.121
143	-3.3	0.091
145	-11.8	0.081
146	-9.2	0.081
207	-2.2	0.128
209	-9.6	0.115
210	-6.9	0.106
255	-3.0	0.095
257	-10.3	0.079
258	-7.9	0.079

Examples 302 to 337



Example	L^1	L^2	L^3	L^4	R
302	H	F	H	H	CH_3
303	H	F	H	H	C_3H_7
304	H	F	H	H	C_5H_{11}
305	H	F	F	H	C_2H_5
306	H	F	F	H	C_3H_7
307	H	F	F	H	C_6H_{13}
308	F	F	F	F	CH_3
309	F	F	F	F	C_3H_7
310	F	F	F	F	C_5H_{11}
311	H	CF_3	H	H	C_2H_5
312	H	CF_3	H	H	C_3H_7
313	H	CF_3	H	H	C_6H_{13}
314	H	OCF_3	H	H	CH_3
315	H	OCF_3	H	H	C_3H_7
316	H	OCF_3	H	H	C_5H_{11}
317	H	CN	H	H	C_2H_5
318	H	CN	H	H	C_3H_7
319	H	CN	H	H	C_6H_{13}
320	H	CF_3	F	H	C_2H_5
321	H	CF_3	F	H	C_3H_7
322	H	CF_3	F	H	C_6H_{13}
323	H	OCF_3	F	H	CH_3
324	H	OCF_3	F	H	C_3H_7
325	H	OCF_3	F	H	C_5H_{11}

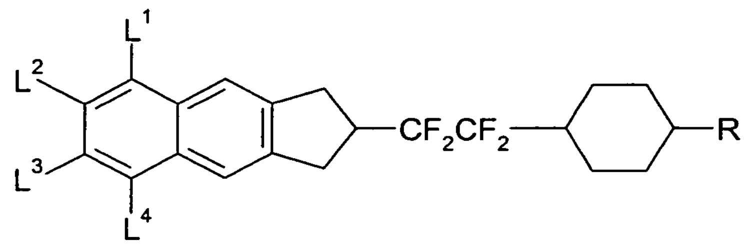
Example	L^1	L^2	L^3	L^4	R
326	H	CF_3	CF_3	H	C_2H_5
327	H	CF_3	CF_3	H	C_3H_7
328	H	CF_3	CF_3	H	C_6H_{13}
329	H	CF_3	OCF_3	H	CH_3
330	H	CF_3	OCF_3	H	C_3H_7
331	H	CF_3	OCF_3	H	C_5H_{11}
332	H	OCF_3	OCF_3	H	C_2H_5
333	H	OCF_3	OCF_3	H	C_3H_7
334	H	OCF_3	OCF_3	H	C_6H_{13}
335	H	CN	CN	H	C_2H_5
336	H	CN	CN	H	C_3H_7
337	H	CN	CN	H	C_6H_{13}

<u>Table 2</u>

$\Delta\varepsilon$ and Δn values for substances of individual examples

Example No.	$\Delta\varepsilon$	Δn
306	12.9	0.179
309	17.0	0.158
312	12.7	0.160
321	23.2	0.159
324	12.4	0.172
327	31.4	0.159
330	19.7	0.143
333	17.4	0.158

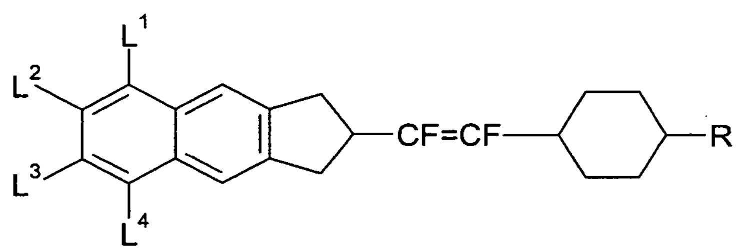
Examples 338 to 367



Example	L^1	L^2	L^3	L^4	R
338	H	F	H	H	CH_3
339	H	F	H	H	C_3H_7
340	H	F	H	H	C_5H_{11}
341	H	F	F	H	C_2H_5
342	H	F	F	H	C_3H_7
343	H	F	F	H	C_6H_{13}
344	F	F	F	F	CH_3
345	F	F	F	F	C_3H_7
346	F	F	F	F	C_5H_{11}
347	H	CF_3	H	H	C_2H_5
348	H	CF_3	H	H	C_3H_7
349	H	CF_3	H	H	C_6H_{13}
350	H	OCF_3	H	H	CH_3
351	H	OCF_3	H	H	C_3H_7
352	H	OCF_3	H	H	C_5H_{11}
353	H	CF_3	F	H	C_2H_5
354	H	CF_3	F	H	C_3H_7
355	H	CF_3	F	H	C_6H_{13}
356	H	OCF_3	F	H	CH_3
357	H	OCF_3	F	H	C_3H_7
358	H	OCF_3	F	H	C_5H_{11}
359	H	CF_3	CF_3	H	C_2H_5
360	H	CF_3	CF_3	H	C_3H_7
361	H	CF_3	CF_3	H	C_6H_{13}

Example	L^1	L^2	L^3	L^4	R
362	H	CF_3	OCF_3	H	CH_3
363	H	CF_3	OCF_3	H	C_3H_7
364	H	CF_3	OCF_3	H	C_5H_{11}
365	H	OCF_3	OCF_3	H	C_2H_5
366	H	OCF_3	OCF_3	H	C_3H_7
367	H	OCF_3	OCF_3	H	C_6H_{13}

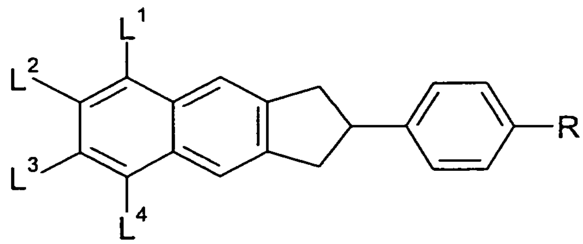
Examples 368 to 397



Example	L^1	L^2	L^3	L^4	R
368	H	F	H	H	CH_3
369	H	F	H	H	C_3H_7
370	H	F	H	H	C_5H_{11}
371	H	F	F	H	C_2H_5
372	H	F	F	H	C_3H_7
373	H	F	F	H	C_6H_{13}
374	F	F	F	F	CH_3
375	F	F	F	F	C_3H_7
376	F	F	F	F	C_5H_{11}
377	H	CF_3	H	H	C_2H_5
378	H	CF_3	H	H	C_3H_7
379	H	CF_3	H	H	C_6H_{13}
380	H	OCF_3	H	H	CH_3
381	H	OCF_3	H	H	C_3H_7
382	H	OCF_3	H	H	C_5H_{11}
383	H	CF_3	F	H	C_2H_5

Example	L^1	L^2	L^3	L^4	R
384	H	CF_3	F	H	C_3H_7
385	H	CF_3	F	H	C_6H_{13}
386	H	OCF_3	F	H	CH_3
387	H	OCF_3	F	H	C_3H_7
388	H	OCF_3	F	H	C_5H_{11}
389	H	CF_3	CF_3	H	C_2H_5
390	H	CF_3	CF_3	H	C_3H_7
391	H	CF_3	CF_3	H	C_6H_{13}
392	H	CF_3	OCF_3	H	CH_3
393	H	CF_3	OCF_3	H	C_3H_7
394	H	CF_3	OCF_3	H	C_5H_{11}
395	H	OCF_3	OCF_3	H	C_2H_5
396	H	OCF_3	OCF_3	H	C_3H_7
397	H	OCF_3	OCF_3	H	C_6H_{13}

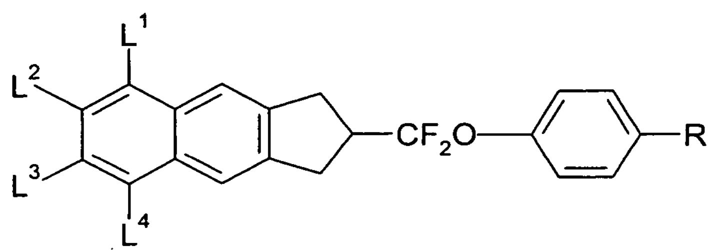
Examples 398 to 427



Example	L^1	L^2	L^3	L^4	R
398	H	F	H	H	CH_3
399	H	F	H	H	C_3H_7
400	H	F	H	H	C_5H_{11}
401	H	F	F	H	C_2H_5
402	H	F	F	H	C_3H_7
403	H	F	F	H	C_6H_{13}
404	F	F	F	F	CH_3
405	F	F	F	F	C_3H_7
406	F	F	F	F	C_5H_{11}
407	H	CF_3	H	H	C_2H_5
408	H	CF_3	H	H	C_3H_7
409	H	CF_3	H	H	C_6H_{13}
410	H	OCF_3	H	H	CH_3
411	H	OCF_3	H	H	C_3H_7
412	H	OCF_3	H	H	C_5H_{11}
413	H	CF_3	F	H	C_2H_5
414	H	CF_3	F	H	C_3H_7
415	H	CF_3	F	H	C_6H_{13}
416	H	OCF_3	F	H	CH_3
417	H	OCF_3	F	H	C_3H_7
418	H	OCF_3	F	H	C_5H_{11}
419	H	CF_3	CF_3	H	C_2H_5
420	H	CF_3	CF_3	H	C_3H_7
421	H	CF_3	CF_3	H	C_6H_{13}

Example	L^1	L^2	L^3	L^4	R
422	H	CF_3	OCF_3	H	CH_3
423	H	CF_3	OCF_3	H	C_3H_7
424	H	CF_3	OCF_3	H	C_5H_{11}
425	H	OCF_3	OCF_3	H	C_2H_5
426	H	OCF_3	OCF_3	H	C_3H_7
427	H	OCF_3	OCF_3	H	C_6H_{13}

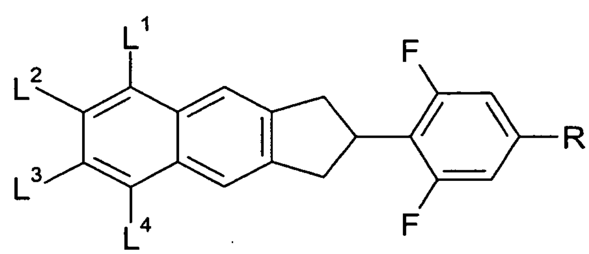
Examples 428 to 457



Example	L^1	L^2	L^3	L^4	R
428	H	F	H	H	CH_3
429	H	F	H	H	C_3H_7
430	H	F	H	H	C_5H_{11}
431	H	F	F	H	C_2H_5
432	H	F	F	H	C_3H_7
433	H	F	F	H	C_6H_{13}
434	F	F	F	F	CH_3
435	F	F	F	F	C_3H_7
436	F	F	F	F	C_5H_{11}
437	H	CF_3	H	H	C_2H_5
438	H	CF_3	H	H	C_3H_7
439	H	CF_3	H	H	C_6H_{13}
440	H	OCF_3	H	H	CH_3
441	H	OCF_3	H	H	C_3H_7
442	H	OCF_3	H	H	C_5H_{11}
443	H	CF_3	F	H	C_2H_5

Example	L^1	L^2	L^3	L^4	R
444	H	CF_3	F	H	C_3H_7
445	H	CF_3	F	H	C_6H_{13}
446	H	OCF_3	F	H	CH_3
447	H	OCF_3	F	H	C_3H_7
448	H	OCF_3	F	H	C_5H_{11}
449	H	CF_3	CF_3	H	C_2H_5
450	H	CF_3	CF_3	H	C_3H_7
451	H	CF_3	CF_3	H	C_6H_{13}
452	H	CF_3	OCF_3	H	CH_3
453	H	CF_3	OCF_3	H	C_3H_7
454	H	CF_3	OCF_3	H	C_5H_{11}
455	H	OCF_3	OCF_3	H	C_2H_5
456	H	OCF_3	OCF_3	H	C_3H_7
457	H	OCF_3	OCF_3	H	C_6H_{13}

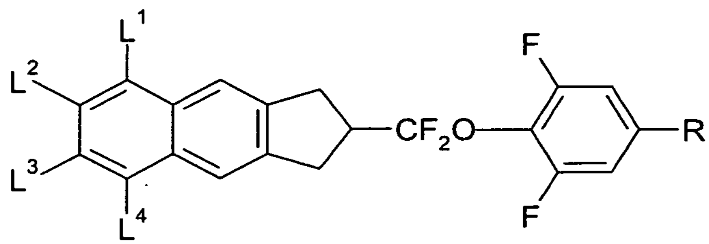
Examples 458 to 487



Example	L^1	L^2	L^3	L^4	R
458	H	F	H	H	CH_3
459	H	F	H	H	C_3H_7
460	H	F	H	H	C_5H_{11}
461	H	F	F	H	C_2H_5
462	H	F	F	H	C_3H_7
463	H	F	F	H	C_6H_{13}
464	F	F	F	F	CH_3
465	F	F	F	F	C_3H_7

Example	L^1	L^2	L^3	L^4	R
466	F	F	F	F	C_5H_{11}
467	H	CF_3	H	H	C_2H_5
468	H	CF_3	H	H	C_3H_7
469	H	CF_3	H	H	C_6H_{13}
470	H	OCF_3	H	H	CH_3
471	H	OCF_3	H	H	C_3H_7
472	H	OCF_3	H	H	C_5H_{11}
473	H	CF_3	F	H	C_2H_5
474	H	CF_3	F	H	C_3H_7
475	H	CF_3	F	H	C_6H_{13}
476	H	OCF_3	F	H	CH_3
477	H	OCF_3	F	H	C_3H_7
478	H	OCF_3	F	H	C_5H_{11}
479	H	CF_3	CF_3	H	C_2H_5
480	H	CF_3	CF_3	H	C_3H_7
481	H	CF_3	CF_3	H	C_6H_{13}
482	H	CF_3	OCF_3	H	CH_3
483	H	CF_3	OCF_3	H	C_3H_7
484	H	CF_3	OCF_3	H	C_5H_{11}
485	H	OCF_3	OCF_3	H	C_2H_5
486	H	OCF_3	OCF_3	H	C_3H_7
487	H	OCF_3	OCF_3	H	C_6H_{13}

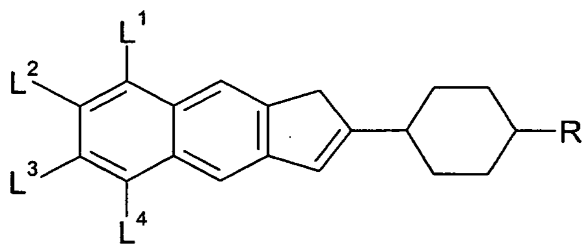
Examples 488 to 517



Example	L^1	L^2	L^3	L^4	R
488	H	F	H	H	CH_3
489	H	F	H	H	C_3H_7
490	H	F	H	H	C_5H_{11}
491	H	F	F	H	C_2H_5
492	H	F	F	H	C_3H_7
493	H	F	F	H	C_6H_{13}
494	F	F	F	F	CH_3
495	F	F	F	F	C_3H_7
496	F	F	F	F	C_5H_{11}
497	H	CF_3	H	H	C_2H_5
498	H	CF_3	H	H	C_3H_7
499	H	CF_3	H	H	C_6H_{13}
500	H	OCF_3	H	H	CH_3
501	H	OCF_3	H	H	C_3H_7
502	H	OCF_3	H	H	C_5H_{11}
503	H	CF_3	F	H	C_2H_5
504	H	CF_3	F	H	C_3H_7
505	H	CF_3	F	H	C_6H_{13}
506	H	OCF_3	F	H	CH_3
507	H	OCF_3	F	H	C_3H_7
508	H	OCF_3	F	H	C_5H_{11}
509	H	CF_3	CF_3	H	C_2H_5
510	H	CF_3	CF_3	H	C_3H_7
511	H	CF_3	CF_3	H	C_6H_{13}

Example	L^1	L^2	L^3	L^4	R
512	H	CF_3	OCF_3	H	CH_3
513	H	CF_3	OCF_3	H	C_3H_7
514	H	CF_3	OCF_3	H	C_5H_{11}
515	H	OCF_3	OCF_3	H	C_2H_5
516	H	OCF_3	OCF_3	H	C_3H_7
517	H	OCF_3	OCF_3	H	C_6H_{13}

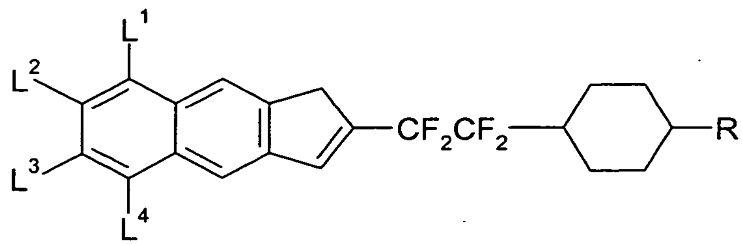
Examples 518 to 547



Example	L^1	L^2	L^3	L^4	R
518	H	F	H	H	CH_3
519	H	F	H	H	C_3H_7
520	H	F	H	H	C_5H_{11}
521	H	F	F	H	C_2H_5
522	H	F	F	H	C_3H_7
523	H	F	F	H	C_6H_{13}
524	F	F	F	F	CH_3
525	F	F	F	F	C_3H_7
526	F	F	F	F	C_5H_{11}
527	H	CF_3	H	H	C_2H_5
528	H	CF_3	H	H	C_3H_7
529	H	CF_3	H	H	C_6H_{13}
530	H	OCF_3	H	H	CH_3
531	H	OCF_3	H	H	C_3H_7
532	H	OCF_3	H	H	C_5H_{11}

Example	L^1	L^2	L^3	L^4	R
533	H	CF_3	F	H	C_2H_5
534	H	CF_3	F	H	C_3H_7
535	H	CF_3	F	H	C_6H_{13}
536	H	OCF_3	F	H	CH_3
537	H	OCF_3	F	H	C_3H_7
538	H	OCF_3	F	H	C_5H_{11}
539	H	CF_3	CF_3	H	C_2H_5
540	H	CF_3	CF_3	H	C_3H_7
541	H	CF_3	CF_3	H	C_6H_{13}
542	H	CF_3	OCF_3	H	CH_3
543	H	CF_3	OCF_3	H	C_3H_7
544	H	CF_3	OCF_3	H	C_5H_{11}
545	H	OCF_3	OCF_3	H	C_2H_5
546	H	OCF_3	OCF_3	H	C_3H_7
547	H	OCF_3	OCF_3	H	C_6H_{13}

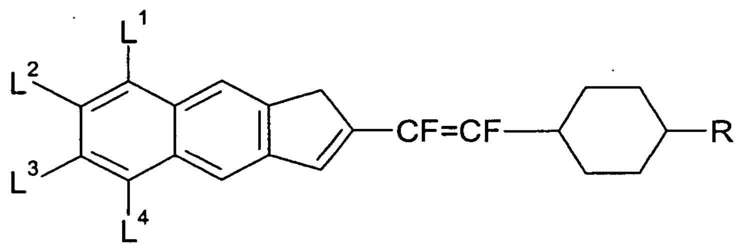
Examples 548 to 577



Example	L^1	L^2	L^3	L^4	R
548	H	F	H	H	CH_3
549	H	F	H	H	C_3H_7
550	H	F	H	H	C_5H_{11}
551	H	F	F	H	C_2H_5
552	H	F	F	H	C_3H_7
553	H	F	F	H	C_6H_{13}
554	F	F	F	F	CH_3
555	F	F	F	F	C_3H_7
556	F	F	F	F	C_5H_{11}
557	H	CF_3	H	H	C_2H_5
558	H	CF_3	H	H	C_3H_7
559	H	CF_3	H	H	C_6H_{13}
560	H	OCF_3	H	H	CH_3
561	H	OCF_3	H	H	C_3H_7
562	H	OCF_3	H	H	C_5H_{11}
563	H	CF_3	F	H	C_2H_5
564	H	CF_3	F	H	C_3H_7
565	H	CF_3	F	H	C_6H_{13}
566	H	OCF_3	F	H	CH_3
567	H	OCF_3	F	H	C_3H_7
568	H	OCF_3	F	H	C_5H_{11}
569	H	CF_3	CF_3	H	C_2H_5
570	H	CF_3	CF_3	H	C_3H_7
571	H	CF_3	CF_3	H	C_6H_{13}

Example	L^1	L^2	L^3	L^4	R
572	H	CF_3	OCF_3	H	CH_3
573	H	CF_3	OCF_3	H	C_3H_7
574	H	CF_3	OCF_3	H	C_5H_{11}
575	H	OCF_3	OCF_3	H	C_2H_5
576	H	OCF_3	OCF_3	H	C_3H_7
577	H	OCF_3	OCF_3	H	C_6H_{13}

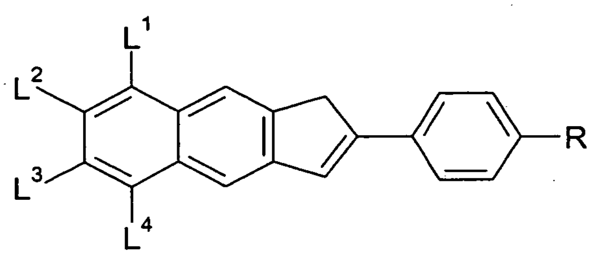
Examples 578 to 607



Example	L^1	L^2	L^3	L^4	R
578	H	F	H	H	CH_3
579	H	F	H	H	C_3H_7
580	H	F	H	H	C_5H_{11}
581	H	F	F	H	C_2H_5
582	H	F	F	H	C_3H_7
583	H	F	F	H	C_6H_{13}
584	F	F	F	F	CH_3
585	F	F	F	F	C_3H_7
586	F	F	F	F	C_5H_{11}
587	H	CF_3	H	H	C_2H_5
588	H	CF_3	H	H	C_3H_7
589	H	CF_3	H	H	C_6H_{13}
590	H	OCF_3	H	H	CH_3
591	H	OCF_3	H	H	C_3H_7
592	H	OCF_3	H	H	C_5H_{11}
593	H	CF_3	F	H	C_2H_5

Example	L^1	L^2	L^3	L^4	R
594	H	CF_3	F	H	C_3H_7
595	H	CF_3	F	H	C_6H_{13}
596	H	OCF_3	F	H	CH_3
597	H	OCF_3	F	H	C_3H_7
598	H	OCF_3	F	H	C_5H_{11}
599	H	CF_3	CF_3	H	C_2H_5
600	H	CF_3	CF_3	H	C_3H_7
601	H	CF_3	CF_3	H	C_6H_{13}
602	H	CF_3	OCF_3	H	CH_3
603	H	CF_3	OCF_3	H	C_3H_7
604	H	CF_3	OCF_3	H	C_5H_{11}
605	H	OCF_3	OCF_3	H	C_2H_5
606	H	OCF_3	OCF_3	H	C_3H_7
607	H	OCF_3	OCF_3	H	C_6H_{13}

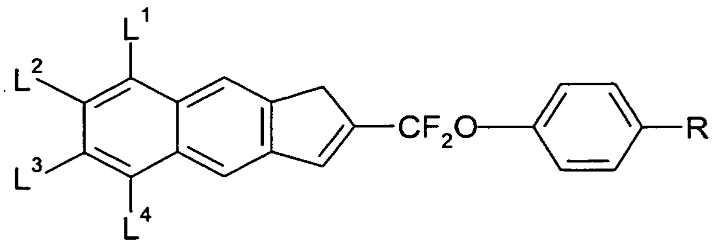
Examples 608 to 637



Example	L^1	L^2	L^3	L^4	R
608	H	F	H	H	CH_3
609	H	F	H	H	C_3H_7
610	H	F	H	H	C_5H_{11}
611	H	F	F	H	C_2H_5
612	H	F	F	H	C_3H_7
613	H	F	F	H	C_6H_{13}
614	F	F	F	F	CH_3
615	F	F	F	F	C_3H_7

Example	L^1	L^2	L^3	L^4	R
616	F	F	F	F	C_5H_{11}
617	H	CF_3	H	H	C_2H_5
618	H	CF_3	H	H	C_3H_7
619	H	CF_3	H	H	C_6H_{13}
620	H	OCF_3	H	H	CH_3
621	H	OCF_3	H	H	C_3H_7
622	H	OCF_3	H	H	C_5H_{11}
623	H	CF_3	F	H	C_2H_5
624	H	CF_3	F	H	C_3H_7
625	H	CF_3	F	H	C_6H_{13}
626	H	OCF_3	F	H	CH_3
627	H	OCF_3	F	H	C_3H_7
628	H	OCF_3	F	H	C_5H_{11}
629	H	CF_3	CF_3	H	C_2H_5
630	H	CF_3	CF_3	H	C_3H_7
631	H	CF_3	CF_3	H	C_6H_{13}
632	H	CF_3	OCF_3	H	CH_3
633	H	CF_3	OCF_3	H	C_3H_7
634	H	CF_3	OCF_3	H	C_5H_{11}
635	H	OCF_3	OCF_3	H	C_2H_5
636	H	OCF_3	OCF_3	H	C_3H_7
637	H	OCF_3	OCF_3	H	C_6H_{13}

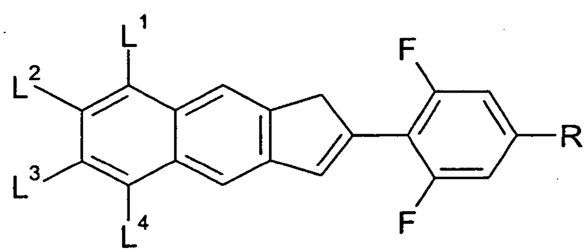
Examples 638 to 667



Example	L^1	L^2	L^3	L^4	R
638	H	F	H	H	CH_3
639	H	F	H	H	C_3H_7
640	H	F	H	H	C_5H_{11}
641	H	F	F	H	C_2H_5
642	H	F	F	H	C_3H_7
643	H	F	F	H	C_6H_{13}
644	F	F	F	F	CH_3
645	F	F	F	F	C_3H_7
646	F	F	F	F	C_5H_{11}
647	H	CF_3	H	H	C_2H_5
648	H	CF_3	H	H	C_3H_7
649	H	CF_3	H	H	C_6H_{13}
650	H	OCF_3	H	H	CH_3
651	H	OCF_3	H	H	C_3H_7
652	H	OCF_3	H	H	C_5H_{11}
653	H	CF_3	F	H	C_2H_5
654	H	CF_3	F	H	C_3H_7
655	H	CF_3	F	H	C_6H_{13}
656	H	OCF_3	F	H	CH_3
657	H	OCF_3	F	H	C_3H_7
658	H	OCF_3	F	H	C_5H_{11}
659	H	CF_3	CF_3	H	C_2H_5
660	H	CF_3	CF_3	H	C_3H_7
661	H	CF_3	CF_3	H	C_6H_{13}

Example	L^1	L^2	L^3	L^4	R
662	H	CF_3	OCF_3	H	CH_3
663	H	CF_3	OCF_3	H	C_3H_7
664	H	CF_3	OCF_3	H	C_5H_{11}
665	H	OCF_3	OCF_3	H	C_2H_5
666	H	OCF_3	OCF_3	H	C_3H_7
667	H	OCF_3	OCF_3	H	C_6H_{13}

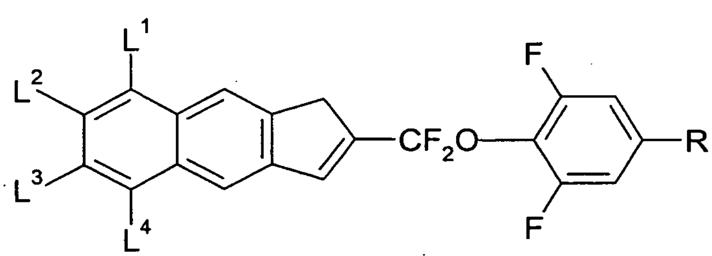
Examples 668 to 697



Example	L^1	L^2	L^3	L^4	R
668	H	F	H	H	CH_3
669	H	F	H	H	C_3H_7
670	H	F	H	H	C_5H_{11}
671	H	F	F	H	C_2H_5
672	H	F	F	H	C_3H_7
673	H	F	F	H	C_6H_{13}
674	F	F	F	F	CH_3
675	F	F	F	F	C_3H_7
676	F	F	F	F	C_5H_{11}
677	H	CF_3	H	H	C_2H_5
678	H	CF_3	H	H	C_3H_7
679	H	CF_3	H	H	C_6H_{13}
680	H	OCF_3	H	H	CH_3
681	H	OCF_3	H	H	C_3H_7
682	H	OCF_3	H	H	C_5H_{11}
683	H	CF_3	F	H	C_2H_5

Example	L^1	L^2	L^3	L^4	R
684	H	CF_3	F	H	C_3H_7
685	H	CF_3	F	H	C_6H_{13}
686	H	OCF_3	F	H	CH_3
687	H	OCF_3	F	H	C_3H_7
688	H	OCF_3	F	H	C_5H_{11}
689	H	CF_3	CF_3	H	C_2H_5
690	H	CF_3	CF_3	H	C_3H_7
691	H	CF_3	CF_3	H	C_6H_{13}
692	H	CF_3	OCF_3	H	CH_3
693	H	CF_3	OCF_3	H	C_3H_7
694	H	CF_3	OCF_3	H	C_5H_{11}
695	H	OCF_3	OCF_3	H	C_2H_5
696	H	OCF_3	OCF_3	H	C_3H_7
697	H	OCF_3	OCF_3	H	C_6H_{13}

Examples 698 to 727



Example	L^1	L^2	L^3	L^4	R
698	H	F	H	H	CH_3
699	H	F	H	H	C_3H_7
700	H	F	H	H	C_5H_{11}
701	H	F	F	H	C_2H_5
702	H	F	F	H	C_3H_7
703	H	F	F	H	C_6H_{13}
704	F	F	F	F	CH_3
705	F	F	F	F	C_3H_7

Example	L^1	L^2	L^3	L^4	R
706	F	F	F	F	C_5H_{11}
707	H	CF_3	H	H	C_2H_5
708	H	CF_3	H	H	C_3H_7
709	H	CF_3	H	H	C_6H_{13}
710	H	OCF_3	H	H	CH_3
711	H	OCF_3	H	H	C_3H_7
712	H	OCF_3	H	H	C_5H_{11}
713	H	CF_3	F	H	C_2H_5
714	H	CF_3	F	H	C_3H_7
715	H	CF_3	F	H	C_6H_{13}
716	H	OCF_3	F	H	CH_3
717	H	OCF_3	F	H	C_3H_7
718	H	OCF_3	F	H	C_5H_{11}
719	H	CF_3	CF_3	H	C_2H_5
720	H	CF_3	CF_3	H	C_3H_7
721	H	CF_3	CF_3	H	C_6H_{13}
722	H	CF_3	OCF_3	H	CH_3
723	H	CF_3	OCF_3	H	C_3H_7
724	H	CF_3	OCF_3	H	C_5H_{11}
725	H	OCF_3	OCF_3	H	C_2H_5
726	H	OCF_3	OCF_3	H	C_3H_7
727	H	OCF_3	OCF_3	H	C_6H_{13}